R&D MANAGEMENT

Start-ups' use of knowledge spillovers for product innovation: the influence of entrepreneurial ecosystems and virtual platforms

Marco Cuvero[1,*], Maria L. Granados[2], Alan Pilkington[2] and Richard Evans[3]

[1]Brunel Business School, Brunel University London, Kingston Lane, UB8 3PH, Uxbridge, London, UK. marco.cuverocalero@brunel.ac.uk
[2]Westminster Business School, University of Westminster, 35 Marylebone Rd, NW1 5LS, London, UK, m.granados1@westminster.ac.uk, a.pilkington@westminster.ac.uk
[3]Faculty of Computer Science, Dalhousie University, Halifax, Nova Scotia B3H 4R2, Canada. r.evans@dal.ca

Entrepreneurial ecosystems have been explored widely in entrepreneurship, management and social sciences literature. The Knowledge Spillover Theory of Entrepreneurship (KSTE) aims to uncover the effects of information on start-ups co-located in diverse locations, such as urban areas, science and technology parks, incubators, and accelerator programs. Extant research has focused on how entrepreneurs launch start-ups and develop patents over a 5–10 years timespan from a regional perspective. However, studies into the development processes of start-ups and the creation of entrepreneurial ecosystems in physical and virtual environments in high-tech start-ups, are limited. As a result, this paper aims to identify the development processes undertaken by high-tech entrepreneurs at the individual level and evaluate the absorption and implementation of knowledge in physical and virtual clusters within entrepreneurial ecosystems. A multiple case study of 32 start-ups that have attended incubator and accelerator programs in London, United Kingdom, is presented. Semi-structured interviews were conducted with Chief Executive Officers (CEOs) and Founders of start-ups to propose the Model of Knowledge Spillovers and Entrepreneurial Ecosystems. The themes identified during interviews highlight the mechanisms employed by start-ups to capture tacit and explicit knowledge spillovers. Theoretically, the findings of this study contribute to the KSTE by questioning the flexibility of entrepreneurs to access knowledge without the limitation of geographical proximity to sources of knowledge. Practically, our findings provide entrepreneurs with proven mechanisms required to capture tacit knowledge spillovers within entrepreneurial ecosystems and use virtual platforms to obtain explicit knowledge spillovers towards product innovation.

1. Introduction

Innovation and knowledge discovery are crucial to ensuring organizational success and competitive advantage. Studies that have evaluated regional growth have increased our understanding of how start-ups are created and their importance to the global economy (Audretsch et al., 2015). More recently, research has uncovered the mechanisms, processes, institutions, and effects of entrepreneurial ecosystems on technological development (Ghio et al., 2019). As a stepping stone, the Knowledge Spillover Theory of Entrepreneurship (KSTE) has provided insights into how entrepreneurs use knowledge and other resources to create new ventures using cutting-edge technologies (Acs et al., 2017). However, extant research has predominantly analyzed entrepreneurial ecosystems at only the regional level, using economic indicators and population characteristics as analysis measurements (Audretsch et al., 2018; Naldi et al., 2020; Audretsch and Belitski, 2021).

Early contributors mainly studied companies' abilities to capture knowledge spillovers from interactions with and between customers, suppliers, and universities. However, such absorption and transformation of knowledge depends on the founders' ability to capture knowledge spillovers and the company's level of absorptive capacity (Audretsch and Link, 2017). Recent research has demonstrated that knowledge spillovers affect start-up performance; however, entrepreneurs must incorporate Research and Development (R&D) activities to engage successfully in innovation activities (Audretsch and Belitski, 2020b). Thus, firms' capability to develop and innovate depends on the co-creation of knowledge in physical and digital platforms and their ability to identify sources of knowledge from multiple industries (Acs et al., 2017).

Extant literature on the KSTE has made several assumptions about entrepreneurs' ability to recognize knowledge spillovers through mechanisms, such as academic publications, movement of human capital, employees' entrepreneurial mindsets, and constant interaction with and between customers and suppliers (Rothaermel and Thursby, 2005; Mathias et al., 2020). Quantitative studies have mostly sought to measure the effects of R&D and the exchange of knowledge between companies in similar industries that share supply chains (Blind and Mangelsdorf, 2013; Huang et al., 2014). However, the exchange of knowledge spillovers between start-ups can equally be limited by budget, organizational performance, and technology in physical and virtual environments (Petruzzelli et al., 2007; Nonaka, 2008).

Research has demonstrated how the creation of new ventures influences economic growth in regions, which occurs through collaboration with universities, financial institutions, and banks that form entrepreneurial ecosystems around start-ups (Ghio et al., 2019). Furthermore, studies have also examined the influence of entrepreneurial ecosystems on entrepreneurs and their ability to absorb knowledge spillovers, visualize opportunities, and use them to enhance firm performance and innovation capability (Link and Sarala, 2019). Therefore, it is essential to understand how entrepreneurial ecosystems facilitate start-up collaborations and alliances and enable entrepreneurs to innovate (Laursen and Salter, 2006; Avnimelech and Schwartz, 2009; Audretsch et al., 2017).

Various sources of knowledge spillovers have been attributed to entrepreneurial ecosystems due to their geographical proximity to highly populated cities (Stuetzer et al., 2017). In addition, incubator and accelerator programs can provide and enhance the opportunities presented to start-ups for networking and knowledge exchange (Shankar and Shepherd, 2018). However, entrepreneurial ecosystems constantly change due to the fast pace of technological change and the innovation developed in the early stages of start-up creation (Wiklund et al., 2019). Moreover, research necessitates the establishment of a foundation that enables reliable metrics that prove the existence of entrepreneurial ecosystems and how start-ups engage with companies and other relevant institutions. Thus, start-up research must consider using digital platforms to co-create knowledge with companies and universities and attain opportunities that extend to virtual entrepreneurial ecosystems (Carayannis et al., 2018; Fellnhofer, 2021).

This study, therefore, aims to explore how entrepreneurs absorb knowledge spillovers in entrepreneurial ecosystems defined by geographical boundaries and virtual environments that use technological tools to surpass the barriers of geographical proximity (Audretsch et al., 2018; Autio et al., 2018). We examine start-ups' co-creation of knowledge and engagement with open innovation in virtual spaces that facilitate the exchange of information and practices among entrepreneurs and innovations (Torre, 2008; De Silva and Wright, 2019) and posit that these virtual platforms overcome the barriers of geographical proximity; in this regard, this study extends current understanding about the effects of knowledge spillovers on entrepreneurial ecosystems. Ultimately, this study aims to answer the following research questions:

1. What resources do entrepreneurs exploit within the physical boundaries of an entrepreneurial ecosystem for product innovation?
2. How do technological tools facilitate access to knowledge spillovers from entrepreneurial ecosystems through virtual platforms?

To answer these questions, the context of entrepreneurial ecosystems and innovation activity within the boundary of urban cities is established, focusing on the influencing effects of accelerator and incubator programs, start-up companies, and governments, which act as sources of knowledge to start-ups (Audretsch and Belitski, 2017; Autio et al., 2018). As part of this, we use the context of entrepreneurial ecosystems surrounding incubator and accelerator programs and illustrate the associated mechanisms for accessing knowledge spillovers in physical and virtual platforms from local and international sources. This study uses a multiple case-study approach at the individual level of high and medium-tech entrepreneurs informed by Chief Executive officers or founders of start-ups. Our analysis considers the involvement of start-ups with other companies and mentors, forming alliances or collaborations and maintaining a group that shares knowledge.

From a theoretical perspective, this study contributes to the KSTE and current literature on entrepreneurial ecosystems by determining the infrastructures and services provided within the physical proximity of urban areas. Moreover, the managerial decisions taken by start-ups to locate themselves within and outside entrepreneurial ecosystems by establishing remote companies and teams and engaging in digital platforms are identified. Our findings reveal that access to knowledge spillovers is largely tied to the geographical proximity of entrepreneurial ecosystems but can also be attained outside its boundaries through the mobility of human capital and the use of technological tools.

2. Literature review

2.1. Knowledge spillovers

The knowledge spillover theory of entrepreneurship seeks to uncover and explain the entrepreneurial processes for creating new ventures (Audretsch et al., 2010). It explores how factors, including employment levels, cultural diversity, investment in R&D, and population density, impact the creation and continued success of start-ups (Audretsch et al., 2010). Often, start-ups are established in clusters alongside other companies, such as incubator or accelerator initiatives, Science and Technology Parks (STPs), and University Technology Transfer Offices (TTOs). Hence, companies are often located in densely populated areas, such as Silicon Valley or London (Audretsch et al., 2015), which means that start-ups benefit from close geographical proximity to a variety of sources of knowledge (Desrochers et al., 2009).

Start-ups do not possess the financial resources and human capital to compete in this regard and, therefore, rely on external, unintended information sharing, known as knowledge spillovers, which considers all informal interactions and relies not on the founders' prior experiences. The KSTE posits that innovation in start-ups is derived from their geographical proximity to knowledge sources in entrepreneurial ecosystems (Audretsch and Lehmann, 2010). The founder's initial training, knowledge, experiences, and connections enable new products or services that use knowledge spillovers to generate a competitive advantage (Nieto and Quevedo, 2005; Montoro-Sánchez et al., 2011). In addition, participation in digital platforms provides access to communities of entrepreneurs that share common interests, experiences, and market information (Nonaka, 2008; Blind and Mangelsdorf, 2013; Audretsch and Belitski, 2017).

Prior studies on knowledge spillovers have typically focused on two forms of knowledge: tacit knowledge, which can be transferred through physical locations, such as conferences, incubators or accelerators, and explicit knowledge, which is transferred through virtual platforms, such as slack channels, blogs, and other user-centered information and communication technologies (Nonaka, 2008; Bandera et al., 2016). Tacit knowledge is obtained mainly by attending events and through experiences which occur through informal interactions and the mobility of human capital. It is based on the actions, procedures, and subjective norms subject to values or beliefs that are difficult to capture and transfer (Nonaka et al., 2000; Yi et al., 2021). These characteristics enable explicit knowledge to be considered either centralized by the company or decentralized and accessible that can be used directly to enhance the performance of companies, open product innovation, and R&D projects, while preventing knowledge leakage (Chen et al., 2011; Wang and Wang, 2012; Cui et al., 2021).

Recent studies have highlighted that knowledge spillovers are restricted not only by other institutions within an entrepreneurial ecosystem but also by entrepreneurs' ability to evaluate R&D and the different sources of tacit and explicit knowledge spillovers (Audretsch et al., 2021). For example, tacit knowledge spillovers can be developed and

captured from exchanges with suppliers, customers, competitors, universities, and governments (De Faria et al., 2010; Spithoven and Teirlinck, 2015; Hájek and Stejskal, 2018). In contrast, explicit knowledge spillovers can be attained through access to corporate white papers, scientific journals, online communities, and conferences and exhibitions (Chun and Mun, 2012; Sisodiya et al., 2013).

This research considers the initial knowledge depth and breadth, background, and movement of economic agents from incumbents and universities on entrepreneurs' ability to identify specific sources of knowledge spillovers (Ko and Liu, 2019). As a result, start-ups and the human capital involved in entrepreneurship can be considered conduits of innovation. Recent studies have highlighted that entrepreneurs capable of collaborating with other firms within an ecosystem demonstrate the same level of innovation (Audretsch and Belitski, 2020a). Once start-ups engage in open innovation and access explicit knowledge spillovers, the barriers of geographical proximity can be overcome by participating in virtual platforms (Torre, 2008).

However, the question remains to consider how organizations, such as universities, incubators, or accelerators, attract skilled human capital to relocate within the boundaries of entrepreneurial ecosystems and promote entrepreneurs to partner with organizations locally (Autio et al., 2018). Thus, it is relevant to evaluate start-ups' capability to implement external knowledge with partners locally and internationally by bypassing competition and using technological tools to attain explicit knowledge spillovers (Chen et al., 2020; Yi et al., 2021). In this regard, the start-up must be able to exploit local and international sources of knowledge spillovers to identify entrepreneurial opportunities, reduce operational costs, and penetrate local and international markets (Lindstrand and Hånell, 2017). The shortcomings in literature also create the possibility to assess if incubators are strictly in physical locations or if they can be virtual using technological tools (Carayannis and Zedtwitz, 2005). Therefore, our discussions stress the importance of identifying how tacit and explicit knowledge spillovers are absorbed within and outside the boundaries of entrepreneurial ecosystems by establishing the following assumptions:

Assumption 1 Start-ups access tacit knowledge spillovers in entrepreneurial ecosystems by locating themselves close to universities, companies, institutions, and incubator and accelerator programs. This access depends on the founder's background and the start-up's human capital mobility.

Assumption 2 Start-ups access explicit knowledge spillovers through technological tools not restricted to geographical proximity and dependent on virtual platforms and technological tools. Explaining explicit knowledge spillovers is conducted by entering online entrepreneurial communities and engagement with public knowledge, such as whitepapers, conferences, and scientific journals.

2.2. *Entrepreneurial ecosystems and clusters of knowledge*

Research suggests that most companies are created in cities with more than 250,000 citizens (Audretsch et al., 2015). Financial institutions, companies, universities, and socio-economic factors lead to the development of entrepreneurial ecosystem indicators (Ghio et al., 2019). However, this domain of research has not been widely explored. Current understanding lacks appreciation of what should be considered a set of boundary conditions to conduct consistent research (Audretsch et al., 2018). As a result, studies have determined various classifications, such as business, innovation, entrepreneurial, and even financial ecosystems (Audretsch and Belitski, 2017).

A new venture that focuses on improving existing products or services depends on the company's absorptive capacity to engage in technical innovation by utilizing available resources and networks to transform knowledge spillovers into economic spillovers (Qian and Acs, 2013; Srivastava et al., 2015). However, researchers suggest that early-stage entrepreneurs focus on the innovation of products rather than process innovation (Wong et al., 2008; Kostopoulos et al., 2011). Further, the understanding of change from entrepreneurs is not focused on disruptive innovation but on revolutionary innovation that seeks to exploit existing technological knowledge to satisfy the market by capturing knowledge spillovers (Yan et al., 2005; Bouncken and Kraus, 2013).

Incubator and accelerator programs provide start-ups with access to networking events to help develop alliances or partnerships with companies in close proximity (Desrochers et al., 2009; Montoro-Sánchez et al., 2011; Shu et al., 2014). They offer mentoring opportunities and training that transfer technical and business knowledge to founders (Bandera et al., 2016). However, the main driver for taking part in such programs is the potential to gain access to investors (Narula and Santangelo, 2009). Such programs depend on the program's capability and services and the activities the entrepreneurs participate (Markovitch et al., 2015; Pauwels et al., 2016).

On the one hand, university incubators support entrepreneurs through engagement in research projects that lead to patenting. Therefore, spinouts of start-ups, generated by academic partners, mainly access tacit knowledge spillovers that are transferred and maintained within the geographical boundaries of entrepreneurial ecosystems (Kolympiris and Klein, 2017). On the other hand, accelerator programs and business incubators focus predominantly on providing start-ups with workspaces and have a more rigid process of selecting entrepreneurs to provide services, such as mentoring, and attaining investment from angel capitalists (Pauwels et al., 2016; Prexl et al., 2019). Thus, entrepreneurs seek access to the required business advice and investment to start a company, and consider locating themselves on the premises of incubators or science and technology parks at the core of entrepreneurial ecosystems (Audretsch and Belitski, 2019, 2021).

The final generated explicit knowledge is accessible to entrepreneurs and allows for developing clusters of entrepreneurial innovation (Huggins and Thompson, 2015). Furthermore, entrepreneurs use technological tools to foster collaboration between companies (Connell et al., 2014). Virtual platforms enable the exchange and access of explicit knowledge spillovers at reduced costs and support future collaborations (Lee et al., 2008; Wiklund et al., 2019). Therefore, such technological tools enable access to explicit knowledge spillovers unbounded from geographical proximity. Eventually, the implementation of virtual platforms enables companies to create new possibilities that facilitate automation through digital data *via* open innovation and access to information in the digital domain (Zysman and Kenney, 2018). Although knowledge spillovers are mainly protected by licensing and unprotected access, they are encouraged in collaborations between companies and universities (Shankar and Shepherd, 2018; Datta et al., 2019; Audretsch and Belitski, 2020a).

Thus, the application of digital technologies enables the exchange of knowledge between entrepreneurs and organizations and reducing the boundaries from geographical proximity and country regulations, facilitating the development of networks, and reducing the barriers faced by entrepreneurs to start a business while being employed (Shepherd et al., 2019; Fellnhofer, 2021; van Doren et al., 2022). Moreover, digital platforms supported by reliable, fast internet capabilities enable apart the instructions of machinery from data and coding, which enables flexibility, open direct access to engagement with end users and suppliers to facilitate the co-creation of knowledge and development of products, access flow of goods in the supply change (Audretsch and Belitski, 2017; Autio et al., 2018).

Product innovation is often initially supported by direct investment from investors, business angels or venture capitalists. Start-ups gather resources by establishing alliances and collaborations through former networks or pitching events (von Zedtwitz, 2003; Cohen et al., 2017). The development of a product focuses on innovation that enables market entry through constant interaction between a team and customers (Nieto and Quevedo, 2005; Wang and Wang, 2012). Start-ups can consider that starting with the development of a product affected by perceived competition levels in the market establishes an openness to sharing knowledge (Bouncken and Kraus, 2013).

In this regard, involvement in accelerator programs facilitates access to new networks, resources, and entrepreneurial knowledge (Markovitch et al., 2015; Cantù, 2017; Malecki, 2018). In incubator and accelerator programs, entrepreneurs use virtual tools to exchange knowledge with platform developers, encourage human capital, and access technological knowledge spillovers (Shankar and Shepherd, 2018). This critical scenario shows how for-profit and not-for-profit start-ups are initially rooted in the boundaries of the entrepreneurial ecosystem but can evolve into the development of businesses thought in virtual platforms (Carayannis et al., 2018; Xu et al., 2018). The discussion of the influence of incubator and accelerator programmes led to the development of the following propositions:

Assumption 3 Tacit knowledge spillovers and resources can be attained by attending incubator and accelerator programs. Entrepreneurs seek to attain training and business knowledge and access to investors that enforce innovation and identify entrepreneurial opportunities.

Assumption 4 Incubator and accelerator programs are a conduit to accessing explicit knowledge spillovers through virtual entrepreneurial communities. The influence of technological tools fosters the collaboration of start-ups with universities and engagement with open innovation unbounded to the geographical proximity with entrepreneurial ecosystems.

3. Methodology

In this study, we use an inductive multiple case study approach to uncover how knowledge spillovers are collected from start-ups in the high and medium-tech sectors and identify their approaches toward the access to knowledge spillovers and entrepreneurial ecosystems at the individual level (Bryman

and Bell, 2015; Saunders et al., 2016). This methodology enabled the identification of how and why organizations operate and enabled the assessment of entrepreneurs' behaviors, aptitudes, and perceptions (Yin, 2006). First, we aimed to contact CEOs and founders directly by sending 833 emails, with 323 initial email interactions being received from entrepreneurs. The sample involved companies operating within their first ten years of operation where innovation processes were being undertaken (Qian and Jung, 2017).

Then, we implemented a semi-structured questionnaire supported by the KSTE and Agglomeration theory focusing on the mechanism and effects (Audretsch et al., 2015; Hayter, 2015). The structure of the interview guide involved: (1) support of incubators, accelerator programs, universities, and organizations for start-ups in entrepreneurial ecosystems; (2) mechanisms to absorb and implement knowledge spillovers toward innovation; and (3) entrepreneurial interactions and development of networks, alliances, and knowledge-sharing processes.

In total, 32 semi-structured interviews with CEOs and founders of high-tech start-ups were conducted, each with less than fifteen years of operation that have attended an accelerator or incubator program in London, UK. The classification of high and knowledge-intensive companies was based on the Statistical Classification of Economic Activities in the European Community (NACE), including information technology, electronics, electric equipment, and software development (European Commision, 2008; Timmermans, 2009; Jin et al., 2019). Our unit of analysis was start-ups, and we used a non-probabilistic theoretical sampling method with the target of attaining theoretical saturation and replicability of the data (Saunders et al., 2016). The characteristics of the start-ups and founders that participated in the study can be found in Appendix A.

The interviews were conducted face-to-face at the accelerator and incubator premises and through skype meetings from October to December 2019. The interviews lasted thirty minutes to one hour each and were later transcribed. The data analysis followed an initial deductive approach by identifying relevant themes and concepts through coding and extending them to second-order themes (Yin, 2006; Eisenhardt, 2016). The analysis and development of the model followed a theory-building process, which provides a robust approach to test assumptions from the literature, establish initial deductive themes from the literature, and develop emerging inductive themes from multiple case studies (Yin, 2003; Gräbner and Eisenhardt, 2007). The explicit code development started with identifying initial first-order themes from the literature to discover and develop a proposed model and propositions (Glaser and Strauss, 1967). Then, the authors conducted the analysis using initial open and focused coding of interview transcripts through two series of interactions using NVivo 12 (Saldana, 2015).

4. Findings

Analysis of the interview data resulted in five aggregate theoretical dimensions and thirteen second-order themes that represent the role of entrepreneurial ecosystems and technological mechanisms for knowledge spillovers to develop networks and clusters of knowledge. The discussion of the themes reveals how tacit and explicit knowledge spillovers are used to enhance new ventures' performance toward product innovation. We identified the overarching dimensions, second-order themes, and first-order categories related to the factors involved in entrepreneurial ecosystems and the mechanisms and events used to capture entrepreneurial ecosystems (Figure 1).

The following sections develop the discussion of the second-order themes and the development of the six main propositions driven by our findings, providing a basis for further research. The data structure and the relevant quotations from participants referenced in the analysis are presented in Appendix B.

4.1. Entrepreneurial ecosystems

4.1.1. Infrastructure and services

Literature highlights that in exchange for these associated high costs, the entrepreneur expects to obtain close access to the market, gain knowledge spillovers from attending conferences, and make full use of the infrastructural and digital infrastructure that the entrepreneurial ecosystem has to offer (Woodward et al., 2006; Audretsch and Belitski, 2017). In this form, entrepreneurs are looking for a pool of skilled human capital to hire for the start-up (EE-IS1, EE-IS2). Start-ups outside an entrepreneurial ecosystem may present initial recruitment barriers due to the lack of government support or entrepreneurial institutions (EE-IS1). They also perceive the city as a critical source for obtaining guidance by attending networking events and gaining access to banks and investors (EE-IS3). Thus, entrepreneurs seek to gain access to tacit knowledge spillovers by hiring experienced professionals in the field from the access to entrepreneurial networks and opportunities in face-to-face interactions (Audretsch et al., 2010; Mathias et al., 2020).

At the individual level of entrepreneurs, the availability of mechanisms to gain access to technologies

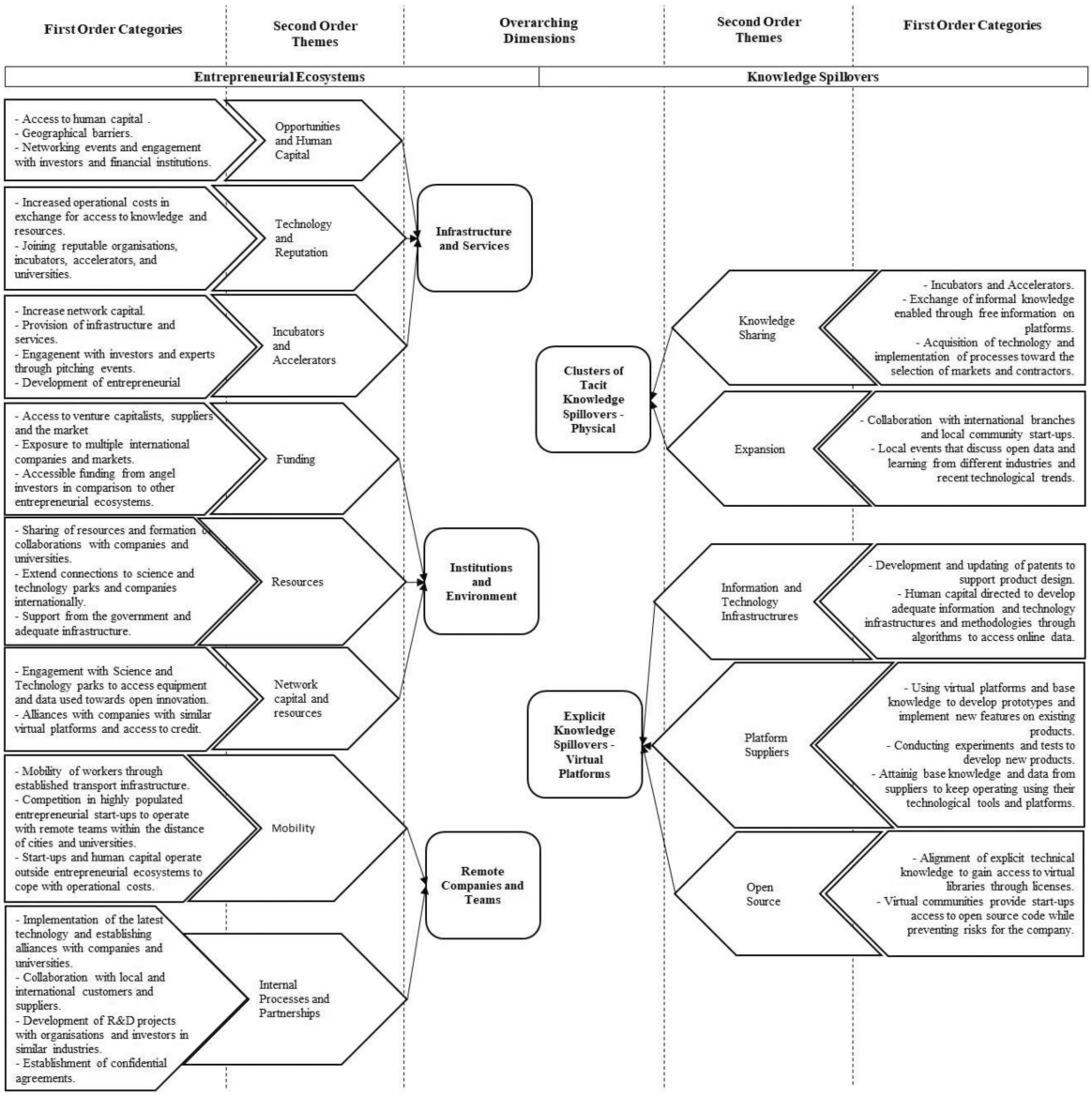

Figure 1. Data structure.

enhances the company's reputation grounded on the background of the founder of the start-up (Autio et al., 2018; Malecki, 2018; De Silva and Wright, 2019). Our data strongly suggest that establishing a company in an ecosystem located in an urban location can incur high expenses caused by the opportunity to access sources of knowledge and resources (EE-IS4, EE-IS5). However, entrepreneurs perceive that locating in a highly dense urban area increases the start-up's reputation and credibility for customers and investors and outweighs the expenses' economic burden. Also, joining established infrastructures leads to necessary access to accelerators, universities, and capital needed to grow in the first years of operation (EE-IS5, EE-IS6).

The data show that accelerator programs allow entrepreneurs to pitch their business idea, increasing their network capital by meeting potential venture capitalists and experts in the field (EE-IS7, EE-IS9). Moreover, access to facilities outweighs the operational costs of hiring human capital and renting premises due to infrastructure and services for running the company (EE-IS8). Our findings strongly suggest that accelerator programs form communities of entrepreneurs who start to transform tacit and explicit knowledge in open spaces. In this case, entrepreneurs would develop a community that incentivizes platforms, such as slack channels, to share knowledge that sets the foundation for removing geographical proximity requirements (EE-IS10). Overall, the data suggest that entrepreneurs are willing to locate within entrepreneurial ecosystems to attain skilled human capital, access to incubators and

accelerators, expand their social network and access to funding through engagement with entrepreneurial communities. These interactions are the initial connections to sources of tacit knowledge spillovers that lead to formal knowledge-sharing. The discussion of the infrastructure and services theme led to the development of the following proposition:

> **Proposition 1** The infrastructure and services available in entrepreneurial ecosystems allow start-ups to gain funding and hire skilled human capital that enhances the start-up's reputation. These conditions contribute to establishing the company and forming local and remote teams based on developing clusters of knowledge from entrepreneurial communities.

4.1.2. Institutions and environment

Entrepreneurial ecosystems provide an adequate structure that facilitates physical infrastructures and digital platforms that promote sharing of knowledge (Autio et al., 2018; Mathias et al., 2020). Our findings suggest that entrepreneurs consider two main perspectives. First, incubators and accelerator programs are considered leading organizations and key players, providing access to venture capitalists, universities, suppliers, and exposure to the market (EE-IE1, EE-IE3). Second, we found that what makes London appealing is access to an open environment that exposes entrepreneurs to various nationalities and cultures with a common language and mindset (EE-IE2). Moreover, entrepreneurs' access to funding and infrastructure in London is at the same level as other thriving entrepreneurial ecosystems in the United States (EE-IE3). In this case, entrepreneurial ecosystems nurture entrepreneurs' capability to engage in thinking designed to embrace new ideas and cultural backgrounds (Audretsch and Belitski, 2017; Audretsch et al., 2018).

The services provided by the identified themes of infrastructure and services potentially lead to collaborative partnerships with companies and universities due to sharing knowledge with experts in the field (EE-IE4). The data suggest that entrepreneurs in the manufacturing and biotechnology industries can obtain equipment from manufacturers and financial support from the government and entrepreneurial organizations (EE-IE4, EE-IE5). The rationale for companies operating in the manufacturing sector is to establish a foundation of operations for the start-up that can last for many years. Hence, high-tech start-ups' motivation is to extend their network capital and operations toward science and technology parks to access technological developments in specific fields (EE-IS7).

On the other hand, new ventures involved in services, software provision, and computer-related activities are aligned to gaining access to larger markets that enable them to obtain higher revenues through direct engagement with potential customers (EE-IS5). In this case, the entrepreneurs' vision is to operate in a market that has a global reach that shares a common language and culture (EE-IE6). Furthermore, companies in this sector aim to build alliances with companies that use similar technological platforms to exchange knowledge (EE-IS8). Finally, start-ups seek to become technology providers for incumbents in some instances. The discussion of the theme of institutions and environment led to the development of the following proposition:

> **Proposition 2** Institutions and companies in an entrepreneurial ecosystem foster an environment for entrepreneurial openness. These conditions facilitate high-tech start-up knowledge sharing, leading to forming alliances, equipment access, and virtual platforms from established companies and science and technology parks.

4.1.3. Remote companies and teams

The KSTE has heavily emphasized the importance of geographical proximity to knowledge spillover sources such as universities and companies. However, our findings suggest that remote companies and teams are the entrepreneurial ecosystem boundary, where resources, human capital, and data are constantly mobbing and habilitating the mobility of knowledge (Mathias et al., 2020; Mota Veiga et al., 2021). Furthermore, the findings suggest that the cost and expenses of maintaining a team and company in the heart of a major city can be a high economic burden for start-ups (CK-RCT1). In such a case, entrepreneurs consider gaining access to universities close to the proximity of the start-up location and using the transportation infrastructure to obtain access to resources from accelerators and universities (CK-RCT2). Thus, entrepreneurs are willing to locate the company's headquarters outside the entrepreneurial ecosystem.

Once the alliance is set, companies focus on adapting their internal processes to align with shared projects, considering implementing technological tools (CK-RTC3). Entrepreneurs can also align their interests with customers locally and abroad (EE-RTC4). Furthermore, developing joint projects with universities involves investing in vital technological tools, such as blockchain, and defining the skilled human capital to develop an initial prototype (CK-RTC5). Finally, the data suggest that start-ups require adequate knowledge protection to prevent vital information appropriation that cannot be shared between partners (CK-RTC6). Thus, remote companies and teams are formed by human capital working

in start-ups or associated with companies and universities within or outside the boundaries of the entrepreneurial ecosystem.

The compilation of remote companies and teams theme suggests that entrepreneurs can decide to locate and hire human capital outside the capital city, still seeking access to its knowledge spillovers, financing, and entrepreneurial institutions. The discussion of the mobility of human capital and engagement of start-ups with international markers led to the development of the following proposition:

> **Proposition 3** High-tech start-ups can gather tacit knowledge spillovers from remote teams located in partners' headquarters. Companies can choose to evaluate the implementation of similar technological tools and knowledge to engage with customers located internationally. Hence, entrepreneurs can manage an entrepreneurial team located outside of the entrepreneurial ecosystem and actively engage in the process of co-creation.

> **Proposition 4** High-tech start-ups implement knowledge management protocols to enable formal alliances to be created to exchange information. Information Technologies facilitate the exchange of explicit knowledge spillovers toward product innovation and the engagement with local and international companies and the market.

4.2. *Knowledge spillovers*

4.2.1. *Clusters of tacit knowledge and the physical environment*

Our data show that tacit knowledge spillovers are critical and include sharing knowledge that can be transferred by face-to-face interactions between individuals or obtained through an individual's experience (Nonaka, 2008). The difference between more structured knowledge management approaches is based on informal and not incurring a value for the knowledge transference. In such a case, high-tech start-ups consider developing continuous engagement with customers in a continuous product innovation process through weekly interactions (CK-TK1).

Similarly, entrepreneurs value access to clusters and inter-sectoral knowledge spillovers by attending events and discussing with experts in various fields (CK-TK2). Accelerators and incubators allow entrepreneurs to enhance their capital network, learning processes, and technology through exposure to knowledge spillovers (CK-TK3). Start-ups expand to other countries by establishing remote teams to new branches and joint ventures internationally (CK-TK4). Additionally, remote companies and teams exchange knowledge that enables them to keep up-to-date with industrial changes (CK-TK5, CK-TS6). Hence, the exchange of knowledge spillovers between companies from similar industries can lead entrepreneurs to engage in product innovation (CK-TKS6). Thus, the effects regional entrepreneurial ecosystem causes the agglomeration of knowledge clusters aligned to the start-up's mission. The discussion of the exchange of tacit knowledge on physical settings led to the development of the following proposition:

> **Proposition 5** Tacit Knowledge Spillovers, gathered from customers, partners, entrepreneurs, and human capital working remotely, provide start-ups with product innovation and prototype development information. Companies and institutions involved at this stage are aligned to common types of new ventures forming communities that develop knowledge clusters.

4.2.2. *Explicit knowledge in virtual environments*

Explicit Knowledge spillover can be obtained through virtual platforms that connect entrepreneurs with companies or data from the worldwide web (Acs et al., 2017). The data show that companies' first approach in industries such as biotechnology is to gather technical knowledge through accessing patents (CS-EK1). However, the start-ups interviewed often decide to gather initial technological knowledge by accessing the world wide web and using skilled human capital to exploit information and technology tools and search strategies (CS-EK2, CS-EK3). Hence, high-tech start-ups prioritize implementing technological tools through innovative exploitation from explicit knowledge spillovers (Nieto and Quevedo, 2005). As a result, high-tech start-ups rely on the use of ICTs to gain access to technological knowledge spillovers founded on the tacit knowledge of hired human capital. Therefore, we can state that entrepreneurs depend on hired human capital's technical expertise to gain knowledge spillovers in virtual environments.

The backbone of the implementation of ICTs is conducted in two ways. First, the start-up requests services from a third party to provide data to the virtual platform (CS-EK4). Once the data are compiled, the company aligns all internal functions with extracting explicit knowledge from the worldwide web. These formal services provide a mechanism for gathering technical knowledge spillovers from the providers (CS-EK5). Hence, start-ups are expected to obtain data, operate the system and keep internal processes up-to-date. Second, high-tech start-ups acquire necessary digital libraries from open-source communities (CS-EK6). This virtual community provides shared knowledge and license fees, potentially moderating access to knowledge.

On the other hand, start-ups can also gather explicit knowledge from open codes and algorithms used in the company's ICTs and virtual platforms (CS-EK7). However, updating systems using these sources of knowledge comes with the risk of harming the company's software base code. The data strongly suggest that digital technological tools foster collaborations and partnerships outside the boundaries of entrepreneurial ecosystems, which require the implementation of common coding languages and platforms. Moreover, entrepreneurs with skilled human capital can capture data and open software that supports open innovation.

Hence, we establish the following proposition:

> **Proposition 6** Explicit knowledge spillovers require skilled human capital to develop virtual platforms. This information technology enables entrepreneurs to support the exchange of explicit knowledge between partners and companies in the supply chain and enhance search functionality through libraries and open codes to extract knowledge spillovers from virtual domains.

The discussion of the theoretical dimension and the development of the propositions enabled us to identify the connections between entrepreneurial ecosystems constrained to geographical locations. The assumptions and development of the propositions enabled the creation of the proposed empirical model (Figure 2). The discussion also enabled us to identify the role of infrastructure and services from incubators, accelerators, and institutions in hiring human capital to develop alliances that motivate collaboration and identify entrepreneurial opportunities. The findings enable us to highlight how start-ups can exploit tacit knowledge spillovers, allocate human capital in remote teams to attend events and facilitate collaborations by exploiting the infrastructure of cities while operating outside entrepreneurial ecosystems. Moreover, companies will implement technological tools to develop alliances and access explicit knowledge spillovers.

5. Discussion

The proposed empirical model considers that knowledge spillovers can be accessed inside and outside the boundaries of entrepreneurial ecosystems. First, the resources available to entrepreneurs in cities focus on identifying and obtaining highly qualified human capital (Schmidt, 2015). As such, access to accelerators and incubators provides access to knowledge that facilitates the company's creation, identifying the industry's requirements and having direct access to banks and investors. However, due to the perceived costs of the start-up's operations, CEOs can decide to locate their headquarters outside the boundaries of the entrepreneurial ecosystem. This finding is critical, as we can state that high-tech start-ups are not obliged to stay close to the city center to gain knowledge, but do need to establish initial engagements with established companies and universities with the technical knowledge required.

Entrepreneurs are willing to trade the operational expenses of working in an urban location for the opportunity of expanding their network of venture capitalists and experts. One possible source of knowledge that does not apply to this finding are universities (Audretsch et al., 2015). In such a case, companies can interact with local universities to gain academic knowledge generated from research

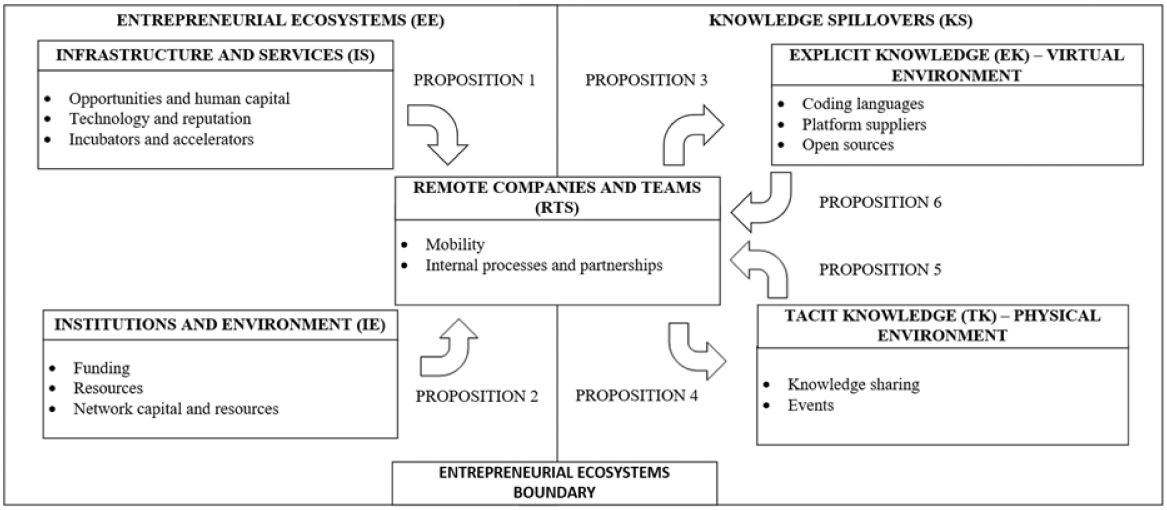

Figure 2. Pathway model of entrepreneurial ecosystems and knowledge spillovers.

projects and articles. Therefore, high-tech companies can exploit human capital that does not have a physical presence in the start-up's headquarters. However, partnerships extended to science and technology parks and universities enable entrepreneurs to gain technological knowledge spillovers from leading academics in the field. This can be achieved in the knowledge-intensive high-tech sector through virtual platforms that facilitate knowledge flow between partners.

The identified sources of knowledge spillovers include business, marketing, and entrepreneurship (Cantù, 2017). In this case, accelerator programs have proven to bridge entrepreneurs to experts and other companies. In addition, high-tech start-ups can form informal collaborations that lead to durable alliances with industry, showing a new form of tacit knowledge spillovers occurring between entrepreneurs and companies. Thus, the findings suggest that locating in the urban core of an entrepreneurial ecosystem exposes entrepreneurs massively to skilled pools of human capital from abroad and to develop collaboration with companies directly and be part of pitching events to gain investment not attainable in other areas. In addition, these entrepreneurial opportunities seem to enhance greatly by the entrepreneur's engagement with an incubator or accelerator program in the entrepreneurial ecosystem. Hence, entrepreneurs choose to locate their headquarters in the urban core of an entrepreneurial ecosystem. However, entrepreneurs can also allocate remote teams, even internationally, to provide technical knowledge spillovers from wider communities and customer bases.

The research suggests that these processes initially encourage entrepreneurs to expand their network and human capital and increase the company's reputation. Furthermore, high-tech companies can access specialized equipment from companies and universities to engage in product innovation. In addition, entrepreneurs gain advice on developing the business within entrepreneurial ecosystems; once complete, they can choose to operate outside urban areas to ease operational costs. One of the aspects that can be overlooked from knowledge spillovers between sectors is that non-competing start-ups can be exposed to diverse knowledge as it is supported by the interactions with the users of innovative products (Verspagen, 1997; Schmidt, 2015).

Similarly, information and technology mechanisms and tools such as machine learning, analytical programs, digital libraries, and virtual platforms can also support innovation. One of our significant findings is that the exchange of incoming knowledge spillovers between companies requires adequate appropriation mechanisms to regulate the flow of knowledge to deal with clients, customers, and competitors (Spithovenm and Knockaert, 2012). Addressing this critical strategic acquisition requires careful consideration within ecosystems and is a prime area for further research. Our data suggest that explicit knowledge spillovers are not restricted to the entrepreneurial ecosystem's geographical proximity (Autio et al., 2018). In these cases, entrepreneurs can access various sources of knowledge for exploratory product innovation, such as patents. Moreover, the findings suggest that high-tech start-ups implementing information technologies can successfully access and exploit public explicit knowledge spillovers.

The data showcases how digital technological tools enable collaboration with companies outside the United Kingdom by providing free accessible content to users and motivating the purchase and visibility of products in local and international markets. Hence, joint projects can be implemented if the companies in the partnership share common virtual platforms and technologies such as blockchain, machine learning, or blogs. Finally, digital technologies enable direct engagement with suppliers located internationally, reducing transactional costs on acquiring goods or services and operational costs by working with virtual platforms operating outside the boundaries of urban cities.

The paper showcases how start-ups will transcend from exploiting the transportation infrastructure used by human capital to access entrepreneurial ecosystems to access tacit knowledge spillovers. Afterwards, entrepreneurs focus on adapting potential virtual entrepreneurial ecosystems supported by digital technological tools and enable collaborations with companies and universities outside the geographical proximity to the company. Thus, the paper has contributed to understanding the progression on which entrepreneurs' requirement to operate near the sources of knowledge reduces as local and international collaborations and access to free available software and data.

6. Conclusions and recommendations

This paper has identified the primary factors and institutions that enforce the process of knowledge spillovers in entrepreneurial ecosystems. We propose a model that can be extended with further research into the development of entrepreneurial ecosystems in physical and virtual locations (Audretsch and Belitski, 2017). The findings suggest that start-ups' access to knowledge spillovers is not limited by geographical proximity and that start-ups often successfully extend their reach

into central hubs from further afield. Start-ups in the high and medium tech sector seek to develop alliances and partnerships with universities and companies to develop new projects based on the latest technologies and knowledge, such as blockchain or advances in biotechnology. Once obtained, entrepreneurs can use technological tools and remote teams to operate outside the boundaries of urban areas and exploit existing transport infrastructure to interact with key stakeholders within entrepreneurial ecosystems. Interestingly, start-ups in the technology and information industry can become a potential source of knowledge spillovers, acting as suppliers of virtual platforms and programs for companies.

The paper has opened the road to explore the exchange of intersectoral business knowledge spillovers as entrepreneurs from different industries unaffected by immediate competition concerns and identifies the existing role of incubators and accelerators. Platforms make this route accessible by utilizing information technologies and web-based systems for explicit knowledge sharing and exploiting incubators for tacit knowledge access. These actions re-enforce knowledge clusters in physical locations and communities in the virtual platform that occurs locally and internationally. The limitation of this study is the relatively small sample size and the types of companies. Still, we are confident that our findings reflect the start-ups we examined, and this aspect could be explored as part of a broader future study.

Finally, this research shed some light on the possibility of considering virtual platforms as digital entrepreneurial ecosystems that are sources of explicit knowledge spillovers and enable entrepreneurs to engage directly with customers and companies outside their entrepreneurial ecosystems to engage in open product innovation projects. The paper has explored the activities of entrepreneurs that operated in entrepreneurial ecosystems and has shed some light on evaluating start-ups that operate outside of well-founded entrepreneurial ecosystems through the development of remote teams and technological tools that evolve the entrepreneur's access to tacit and explicit knowledge spillovers.

DATA AVAILABILITY STATEMENT

The data is not available.

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Marco Cuvero is a Lecturer in Entrepreneurship and Strategy at Brunel University London, United Kingdom. He obtained his PhD from the University of Westminster in 2021, where he researched the effects of knowledge spillovers on high-tech start-ups and product innovation. He is currently conducting research in the implementation of digital technologies by companies. He has authored numerous publications and conference proceedings, including *IEEE Transactions in Engineering Management, Academy of Management Proceedings*, and *IEEE International Conference of Industrial Engineering and Engineering Management (IEEM)*.

Maria L. Granados is a Lecturer in Information Management at University of Westminster in London, United Kingdom. She obtained her PhD from the University of Westminster in 2014 where she researched knowledge management capabilities in social enterprises. She is currently working with international research teams in Brazil and Colombia, studying social innovation and entrepreneurship, informal entrepreneurship and sustainable development. She has authored/co-authored numerous papers in peer-reviewed journals, including *Journal of Social Entrepreneurship*, *Social Enterprise Journal*, *Journal of Knowledge Management*, and *International Journal of Entrepreneurial Behavior & Research*.

Alan Pilkington is a Professor of Technology Management and a chartered engineer. As well as academic positions in many countries, he has worked with international companies, including recently Deliveroo, du and Jaguar Land Rover. His academic research has been published in many leading journals such as *Journal of Operations Management*, and *California Management Review*, and he is also the author of an important textbook on Operations Management for McGraw Hill.

Richard Evans received his Ph.D. degree in enterprise social software from the University of Greenwich, London, U.K., in 2013. He is Associate Professor in Digital Innovation within the Faculty of Computer Science at Dalhousie University, Canada, where he also acts as Program Director for Bachelor of Applied Computer Science. Richard is an established academic with research, teaching and supervision experience in the fields of digital innovation and transformation, design and engineering management, and entrepreneurship. He has authored/coauthored numerous papers in peer-reviewed journals, including *Technological Forecasting and Social Change*, *IEEE Transactions on Engineering Management*, *Computers in Human Behavior*, and the *International Journal of Production Research*.

APPENDIX A
Characteristics of the data, adapted from Cuvero et al. (2019)

Age	Highest qualification	Number of employees	Job position	Years of operation
35	PhD candidate	1	Chief Executive Officer	2
27	Bachelor's Degree	2	Chief Executive Officer	2
36	PhD.	4	Chief Executive Officer	7
49	PhD.	4	Chief Executive Officer	4
39	MBA	4	Chief Executive Officer	4
29	Bachelor's degree	5	Chief Operations Officer	2
41	Bachelor's degree, engineering	5	Chief Executive Officer	4
34	Master's degree	5	Chief Executive Officer	3
38	Master's degree in science	7	Chief Executive Officer	2
31	Doctorate in medicine	8	Operations Director	3
28	Bachelor's degree	8	Chief Executive Officer	2
34	Bachelor's degree	9	Chief Executive Officer	5
34	Master's degree	9	Chief Executive Officer	2
28	Bachelor's degree	9	Chief Executive Officer	4
43	Master's degree	11	Chief Executive Officer	3
42	MBA	11	Chief Executive Officer	4
68	BA Business Manager	12	Executive Chairman	12
25	Master's degree MIT	14	Chief Executive Officer	3
37	Master's degree	15	Chief Executive Officer	3.5
34	Master's degree	15	Chief Executive Officer	6
24	Bachelor's degree	16	Customer Engagement Manager	3
45	Bachelor's degree	19	Chief Executive Officer	3
60	MBA	24	Chief Executive Officer	2
42	MBA	25	Chief Executive Officer	3
50	PhD.	26	Vice president of COC	2
43	MBA	27	Chief Executive Officer	4
50	Master's degree	30	Chief Executive Officer	15
44	BA Science	32	Chief Executive Officer	3
34	MBA	50	Chief Executive Officer	3
55	PhD.	57	Chief Executive Officer	6
47	Bachelor's degree	65	Chief Executive Officer	3
39	Master's degree	80	Chief Executive Officer	7

APPENDIX B
Relevant themes and quotations

Themes	Theme codes	Relevant quotes	Code
Infrastructure and Services	Opportunities and Human Capital	Because from my experience, I know that--- other organizations, in other parts, struggle to recruit because of the location. So, for example, –---- a company in Wales ----- there was significant government support, they established something in Wales and then struggled to recruit people to populate that space.	EE-IS1
		Because I live here, my living place is here. It's a pool of talent. I like London. I like the pace, the international blend.	EE-IS2
		I love it. It is my favorite city in the world. I was first in Manchester in 3 years ---------- I love Manchester, a great city, but when I came to London it was a significant change. I realized just how big the city was: the opportunities, the people, the networks, and the talent. It ticked all the boxes. ----------, you need more money in the U.S., and I had never been or lived there. ----------, and if later I needed, I could move to the U.S.	EE-IS3
	Technology and Reputation	I think it would cause more challenges; having a place in London creates more credibility. If you are in London, people might give you some time, but it becomes much more difficult to set meetings in rural areas, etc.	EE-IS4
		The costs are high, but on the other hand, the concentration of talent is higher you much more people to draw from some of the best universities in the world, some of the best incubator programs, –---- so in a certain sense, it is even easier to start a business in London as opposed to Birmingham or Liverpool.	EE-IS5
		Mainly for financial reasons, if you are building a high cap operation, you need capital. This is easier in some places than in others. Ideally, you would raise it in the VALLEY.	EE-IS6
	Incubators and Accelerators	When you are a young start-up, you got to raise money one way or another. When I came to London, I did not know anyone, but I knew every major B.C. in town in two months. The reason is that I could look in SEEDCAMP portfolio and scan the 150 companies there ---------- so that made a huge difference ---------- we are scared as hell for pitching to people, you know, the largest companies in the world.	EE-IS7
		This incubator? Yeah, I think this is a super incubator, the facilities, the access to space, services to the office. We do not have allowance into the office just to the systems that they have, simple things like electric things that if you are starting from scratch, having to wire up buildings, we do not have to worry about any of that, they take all of the pressure out, some of the hygiene, and other housekeeping factors that are important at the start	EE-IS8
		We had to be there 3 days a week during the program, and most days, they would bring in people for us to meet. They'd be marketing people. --------they could be ------management people; they could be customers. Several investors, we met a lot of V.C., and we met the chief scientist that enthusiast you, so they can talk to us. It's fantastic. It's exceptional. I'd say it's probably one of the best accelerator programs that have been run.	EE-IS9
		There were a few of them, and we could choose the one we were more comfortable with. The community as a whole has gotten very good at sharing ---------- that shared their insights and knowledge ---------- and our industry changes so quickly that you cannot use knowledge like that to educate yourself.----- so it is a vital part of what we do a stacking channel were we share with the whole company articles that are important to read or books so that type of personal development I am doing for investment.	EE-IS10

(Continues)

APPENDIX B Continued

Themes	Theme codes	Relevant quotes	Code
Institutions and Environment	Funding	There is an ecosystem in London that has helped every step ---- in the early stage. There are Accelerator programs, angel investors, lots of V.C's with funding, and a great talent pool.	EE-IE1
		I think London has a great ecosystem, from various perspectives, nationalities, –---------- it is very open country ---- it also has excellent time zones so you can address Europe, U.S and Asia, sitting out of London and that has enormous advantages ---------- you have English as a common language which makes it easy to transact with a lot of different countries. England has good branding, so if you are a British company ---------- a lot of energetic, enthusiastic engineers ---------- there is a lot of sharing of ideas and knowledge.	EE-IE2
		London is a great place to start a business. The infrastructure for young start-ups is relatively mature, –---- a lot of angel money, a lot of capitalist's money available. It is the second biggest market outside the U.S., and many energetic start-ups have succeeded. ------- house sports -- a way of improving as well, so it's a great place to be.	EE-IE3
	Resources	There are good and bad----because there is a lot of feasibility here, a university's collaboration. It's easier to meet people, like manufacturers of equipment, of course, it's expensive, it costs a lot in rent, mostly just in living wages.	EE-IE4
		I moved from Paris to London because there is a lot more money in London for start-ups. SEEDCAMP was the accelerator for us, and the investor ---------- was also our first customer. We had built; we have a great---- system to start and had the market--the market is much more significant in English-speaking countries, like Canada, U.S., and U.K.	EE-IE5
		One of the benefits of the G.F.C. campus, it's got backing, as I said earlier, through ------- organizations. But it's also establishing yourself as a -------- for the U.K., so there's a growing power-----. We've government backing, incentives to develop the manufacturing and ------ distribution from that side. So, you seem --------- could potentially come over the next 10 or 20 years.	EE-IE6
	Network capital and resources	No, not yet because we are in a phase ----- so we can't get ---------- manufactured somewhere else, but there is a potential to do much in the future. We have investigated exploiting ---------- because through the open innovation, they have a group that collaborates with small biotech start-ups. In that science park, but you can establish through contracts, you can develop the options to use ----- on technology --------- and it benefits small start-up, so you can use it and later the data they need--- and they make the decisions buying equipment.	EE-IS7
		At this stage, yes, we have started some alliances with similar platforms. Our system rides on Amazon Web so --- they come and help you, they give you credit they give you a lot of things.---------- will flag us the premium provider of all T.V. Trailers, or we work with other platforms that want U.S. to help THEM. ----- it is all a connected system; it becomes like a market place, so yes, we do that now more than any before.	EE-IS8
Remote Companies and Teams	Mobility	So location wise it does not make a huge difference. London is convenient for getting people to there is a lot of, and that is good, London is not in the middle of nowhere like the accelerator in-----, it is generally expensive, so that is on the downside. I don't think it is good to have a team based in London. There are much competition and too high a cost. So, we don't want to be restricted to just one area.	CK-RTC1
		They have a world-class university in Bath, and it has its bath spa. --- so, within a four-mile radius, there are four good universities. So, I think if you can make the job attractive, there is a promising graduate pool. All the graduates want to get back to London, but it is competitive, and it is expensive. --- so, it suits us at the moment. It is half or a third cheaper in office space, employment than London, and I think --- we need cultivated, inspired people. A lot of it is about scaling and sales, but we will have an office in London.	CK-RTC2
	Internal Processes and Partnerships	We could explore possibilities; we are developing our processes, so to make it change is quite significant. So, you keep an eye on the latest technology, what's happening, what's being discussed, but to make a change, you have to consider new technologies before making that change.	CK-RTC3
		They were very retail-specific connected to ----, and we found ourselves having success with European retailers -------, and it was a way to expand our market. At the end of 2017, we did one more in Munich ---------- which is the largest electronic consumer in Europe ---------- if we select you, then we want to do business with you. ---------- we had 100's of retailers interested in what we were doing.	CK-RTC4
		Yes, We collaborate with Imperial college ----------research and engineering, that is one part of our service that we are looking into, so we have a strong R&D stream and a blockchain, so it is something we worked on together so ---- a prototype, but we are still in ---- study ----------working with students from the science departments	CK-RTC5
		Yeah, the same industry, the same background also, same investors, you can get them to sign a confidential agreement and then you have discussions with them about the project.	CK-RTC6

APPENDIX B Continued

Themes	Theme codes	Relevant quotes	Code
Tacit Knowledge – Physical Environment	Knowledge Sharing	We share a lot of information with our customers, and that is our main BOLGG and passport ---------- for the process of publishing a book and sharing that information is our way of doing marketing. It is something that customers reward us with because we create high-quality contents free, and they can access it, which is why they are more confident in paying for the product.	CK-TK1
		My background was not cybersecurity, but when I participated in cyber London, you know our golden bonus was building that fabulous set of experts in that field. Having their support and challenging our ideas, and getting ---- from advisors who were getting familiar with the topics, it made possible to have a new conversation.	CK-TK2
		The advantage of the accelerator is that you learn a lot from other people. You try more things, you get more ideas about the things you try, and also if it is a good accelerator, you will spend less time on finding people --- It's about management processes, implementation of methodologies, use of technology, sub-contractors, business strategy, selection of technologies, ideas on acquisitions, market penetration, market processes, branding deals.	CK-TK3
	Expansion	we have two more locations, one in Canada and one in the U.S. They don't work on the same projects but collaborate with other branches, other offices, and this office and their projects. We also work primarily with local community start-up. I would say not so much with start-ups that we work with. More like the need for services, we have to reach out to get some job done or built, or design is done.	CK-TK4
		Yes, there was an event three months ago from ELEVATE, which is a sports health industry. It was over open data and how it affects the industry--the core drivers that were interesting--other people interested in the subject and came to speak to me.	CK-TK5
		The reason I do it is that I learn from them ---------- it helps me to think out of the box, I learn different industries ---------- I learn about new emerging technologies all those are the critical perceptions.	CK-TK6
Explicit Knowledge – Virtual Environment	Information and Technology Infrastructures	Patents are the very epicenter of here. Without patents, there's nothing. So patents are critical to what we are doing. And I think actually, something like the F.B.C. would be better served to provide specific support, specific expertise required to ------- a start-up. Like patents, like manufacturing, like good design and critical study. ---- Though spend, our C.S.O. is focused on constantly updating our patents.	CK-EK1
		We are looking for JAVA developers for a----- base to base programming, I.T. infrastructure skills, around the angular framework, evolving platforms. So, we are looking for maximum skill. You have to know algorithms; On the work side, we are looking for experience to understand tech problems.	CK-EK2
		Right now, it has been about using new technology -------- ERLANG or using machine learning infrastructure and Google ---- competitive platforms to build our own. --- structure and methodologies, –-- monistic devices to ---------- based on innovation, enabling us to what we do much faster and become a leader in our industry.	CK-EK3
	Platform Suppliers	We have 65----- dividers that provide the information ---- then draw on algorithms and quantum, it's a video game company, –---- so all in a single stack----. We get the information from data providers, then we do the pipeline process ---- but more is gathering ourselves.	CK-EK4
		Working with platforms like that gives a lot of knowledge, and they help you a lot ----- they would want to keep you as their client. So, they kind of invest in you, give you that knowledge to get you started.	CK-EK5
	Open Source	Libraries and internet that we pay and maintain their service. We also pay ---- for the knowledge they share, and we pay license fees to other organizations. So yes, we use open source and also pay.	CK-EK6
		Yes, it is about free knowledge, it's free code more than free knowledge, but there is some free knowledge. We don't use as much open source as perhaps we should. That is mainly because there are security implications, and also open-source programs are not too much controlled, so you can get a relief that can mess up all your core. Someone's update could affect your --- rollout. So, you have to be very pragmatic about the management source.	CK-EK7