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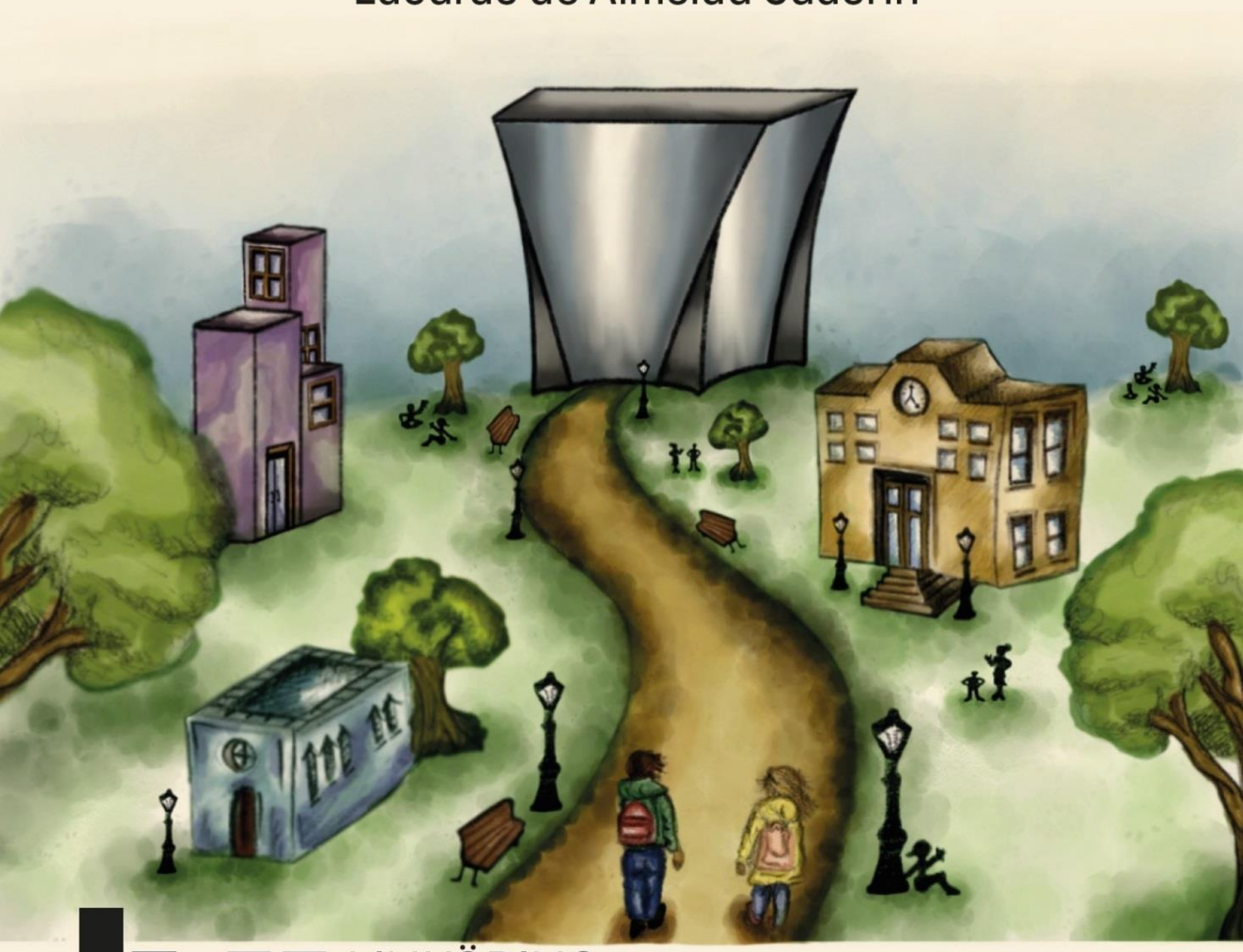
Science Parks and talent attraction:
a study on the development of Science Parks

Eduardo de Almeida Cadorin



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2021

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Abstract

This dissertation investigates the development of Science Parks (SPs) from the perspective of talent attraction activities. Studies on SPs often address only traditional services that parks provide tenant firms. Thus, few studies have focused on activities organised by SPs to attract talent, and even fewer studies have considered the perspective of SP management (supply-side) rather than tenant firms (demand-side). This dissertation argues that the characteristics of the talent attracted to tenant firms and the SP's structure, processes, characteristics, and stakeholder relationships influence SP performance. In addition, the talent attraction activities developed by the SP mediate this influence.

This thesis relies on five papers, both qualitative and quantitative, written in collaboration with other scholars. This study shows that SPs organise talent attraction activities according to the characteristics of the desired talent and park configurations, such as their collaborations with stakeholders and the level of maturity of the tenant firms. These activities provide tenant firms with access to human resources suitable for their growth, contributing to the performance of the SP.

This study contributes to research on the development of SPs by shedding light on how talent attraction activities organised by SPs influence their development. Furthermore, this thesis presents talent attraction as a conceptual element and proposes a model that includes the influence of talent attraction in a supply-side perspective and as a mediator of SP performance.

Finally, this thesis recommends that SP managers support tenant firms of all maturity in the search for qualified professionals, facilitate the entry process of talents and firms from abroad, strengthen ties with the local university and student community and promote a creative, enterprising and innovative environment.

Keywords: *Science Parks, talent attraction, new technology-based firms, students, university, university-external collaboration, success factors.*

Sammanfattning

Avhandlingen studerar Science Parks (SPs) och deras aktiviteter för talangattrahering, med andra ord aktiviteter för att rekrytera talangfulla medarbetare. Studier om SPs berör traditionellt de generella tjänster som SPs erbjuder sina företag, vanligen nya teknikbaserade företag och organisationer. Däremot finns det få tidigare studier inom den akademiska litteraturen om processerna för att attrahera talanger, i synnerhet sådana där analysen mer utgår från SPs försörjningsperspektiv snarare än de lokaliserade företagen och organisationerna (efterfrågeperspektivet). Avhandlingen argumenterar för att flera faktorer påverkar SPs förmåga att attrahera talanger: dels de önskade kvalifikationerna hos medarbetarna, dels hur SPs egna strukturer, processer och intressenter påverkar arbetet. SPs egna aktiviteter för att attrahera talanger fungerar i sammanhanget även som en förmedlare mellan de enskilda företagen och organisationerna och deras potentiella medarbetare.

Avhandlingen baseras främst på fem publikationer, vilka är samförfattade med andra forskare och innehåller såväl kvalitativa som kvantitativa studier. De huvudsakliga resultaten är att SPs organiserar sina aktiviteter för att attrahera talanger dels utifrån de önskade medarbetaregenskaperna, dels efter mognaden hos de lokaliserade företagen. Samarbeten med olika intressenter ger också SPs företag tillgång till viktiga resurser och därmed möjlighet till tillväxt, vilket i sin tur bidrar till SPs prestation i den roll man har för att utveckla företagen, organisationer och samhället.

Avhandlingens främsta forskningsbidrag är dess analys av hur olika aktiviteter för talangattrahering påverkar SPs utveckling och följaktligen prestation. Talangattrahering introduceras i avhandlingen som ett konceptuellt element och en modell utvecklas för talangattrahering både (i) ur ett försörjningsperspektiv och (ii) som en

förmedlare av SPs prestation. Avhandlingen rekommenderar också att ledningen för SPs stödjer lokaliserade företag i sökandet efter skickliga medarbetare, det vill säga både stödjer företag och individer vilka kan ha särskilda behov och samarbetar med universitet för att exempelvis ge möjlighet till kurser och seminarier inom innovation och entreprenörskap. Detta ger även de lokaliserade företagens tillgång till talanger och kunskap vid universiteten och skapar dessutom en attraktiv omgivning för talangfulla medarbetare.

Nyckelord: *Science Parks, talangattraktion, nya teknikbaserade företag, studenter, universitet, universitet-externt samverkan, framgångsfaktorer.*

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This project would not be possible without the support of the Brazilian Army and the financial support of the CNPq[1], through the Science Without Borders project. Many thanks to both of you. *Pátria amada, Brasil!*

I sincerely thank my parents for cultivating in me the desire to seek knowledge constantly.

Last but not least, all my gratitude to my beloved wife Michele and my sweet daughters Giovana and Giulia, of whom I am very proud. Without your support and understanding to accept changes in your lives, this research would not be possible. This thesis is also an achievement of yours.

Thank you all!

Eduardo de Almeida Cadorin, Linköping, 2021.

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Appended papers

Paper 1: Cadorin, E., Johansson, S. G., & Klofsten, M. (2017). Future developments for Science Parks: Attracting and developing talent. Industry and Higher Education, 31(3), 156–167.

Paper 2: Cadorin, E., Klofsten, M., Albahari, A., & Etzkowitz, H. (2020). Science Parks and the attraction of talents: activities and challenges. Triple Helix, 6(1), 36–68.

Paper 3: Cadorin, E., Germain-Alamartine, E., Bienkowska, D., & Klofsten, M. (2019). Universities and Science Parks: Engagements and interactions in developing and attracting talent. In Developing Engaged and Entrepreneurial Universities (pp. 151–169). Singapore: Springer.

Paper 4: Cadorin, E., Klofsten, M., & Löfsten, H. (2021). Science Parks, talent attraction and stakeholder involvement: an international study. Journal of Technology Transfer, 46(1), 1–28.

Paper 5: Löfsten, H., Klofsten, M., & Cadorin, E. (2020). Science Parks and talent attraction management: university students as a strategic resource for innovation and entrepreneurship. European Planning Studies, 28(12), 2465–2488.

Additional papers

Cadorin, E., Klofsten, M., & Johansson, S. G. (2017). The development of a modern Science Park: A Swedish good practise. *Revista Militar de Ciência e Tecnologia*, *34*, 55–59.

Klofsten, M., Norrman, C., Cadorin, E., & Löfsten, H. (2020). Support and development of small and new firms in rural areas: a case study of three regional initiatives. SN Applied Sciences, 2, 1–9.

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PART I: SYNTHESIS

1. INTRODUCTION

This chapter provides the background to this study by discussing Science Parks and talent attraction activities. First, this introduction outlines the relevance of studying Science Parks and how their concept has evolved. Second, this chapter discusses the context in which Science Parks develop activities to attract talent. Third, this chapter identifies potential knowledge gaps in the literature. Fourth, this chapter presents the aim of the thesis and the research questions. Finally, the chapter presents how the thesis is relevant for research and practice.

1.1. The relevance of studying Science Parks

Science Parks support the emergence and development of technology-based firms by providing infrastructure and services (Colombo & Delmastro, 2002; Díez-Vial & Montoro-Sanchez, 2017). In recent decades, scholars have carried out many studies on the relevance, networks, and performance of Science Parks, mainly from the perspective of the tenant firms (Löfsten & Lindelöf, 2002; Ramírez-Alesón & Fernández-Olmos, 2018).

Since most firms in Science Parks are technology-based which depend heavily on access to skilled workers, researchers have started to study the ability of Science Parks to develop mechanisms to tailor solutions for attracting talent (Bellavista & Sanz, 2009; Chen & Yu, 2008; Roldan et al., 2018). Such solutions may involve attracting people with specific knowledge who can facilitate the establishment and development of firms (Gwebu et al., 2018) or attract individuals with general qualifications but great potential to develop their professional skills, such as university students (Tansley & Kirk, 2017).

Universities are a relevant source of knowledge and technology for business innovations (Bozeman, 2000; Cohen et al., 2002; Guerrero & Berbegal-Mirabent, 2016; Salter & Martin, 2001). A greater emphasis on the third mission of universities (see Gulbrandsen & Slipersæter, 2007) has made the transfer of technology and knowledge from universities to industry extremely relevant (Bozeman, 2000; Minguillo & Thelwall, 2015). In addition, the local university generates an annual flow of graduates (Cai & Liu, 2015; Cowling & Lee, 2017; Etzkowitz, 2008; Florida, 1999; Kusmana, 2019), promoting the formation of a pool of highly qualified professionals in Science Parks (Cadorin et al., 2020; Eckardt, 2017).

Talent attraction activities need to be developed to attract professionals who have the characteristics to meet the needs of the tenant firms. These activities should simplify the talent management processes of firms, offering them more agile means of obtaining the desired expertise. In addition to the characteristics of the talents, Science Park features such as infrastructure, processes, and stakeholders can contribute to the planning and execution of the talent attraction activities (Löfsten et al., 2020).

1.2. The emergence of Science Parks

The Science Park concept was originated as an unplanned consequence of a land capitalisation arrangement to raise funds to support the academic development of Stanford University (Etzkowitz & Zhou, 2018; Gillmor, 2004). However, firms moving into Stanford's Industrial Park in the 1960s were not typical manufacturing firms, but firms created by researchers associated with the university who wanted their enterprises to remain closely connected to the source of their ideas and people (Etzkowitz & Zhou, 2018). In the late 1970s and early 1980s in the United States, conditions were favourable for establishing commercial partnerships between universities and firms as a result of various political initiatives, such as the Bayh-Dole Act (Link & Scott, 2006; Sun et al., 2019).

The first generation of Science Parks focused on providing office spaces and production areas near local universities (Rowe, 2014). The concept of knowledge sharing associated with geographical proximity between participants provides ideas and directions for university research and competitive benefits for firms. The proximity to different sources of knowledge, whether tacit or codified, generates many opportunities to create and acquire knowledge and makes the innovation process more efficient (Link & Scott, 2018).

To serve tenants properly, Science Parks need to find a balance between support oriented to configuration and process (Albahari et al., 2011, 2019; Autio & Klofsten, 1998) as land will become more than a soil platform of human activity. That is, land can be seen as a set of systems that provide the infrastructure required for business development. Moreover, high-tech knowledge-based development emanates from a variety of private and public capital such as venture, seed, angel, and hedge capital (Wilson et al., 2018). In addition, the labour market no longer only rewards physical activity but has become increasingly knowledge-intensive and more interested in highly qualified workers (Moussa et al., 2017; Svensson et al., 2012).

Indeed, Science Parks moved from a single purpose organisational model to a multifaceted and interactive organisational mode with a set of responsibilities and more complex relationships (Etzkowitz & Zhou, 2018), which also contribute to the internal processes of tenant firms. In modern versions, Science Parks introduce some new business support mechanisms such as talent attraction activities (Cadorin et al., 2020). Creative and entrepreneurial environments, spaces for events and meetings, and green and leisure areas such as cafes and clubs also contribute to the emergence of new ventures and the attraction of talent (Florida & Mellander, 2015). A Science Park’s brand, built mainly through social networks, the internet, and social media, is one of the most valuable assets delivered to tenants (Cadorin, Johansson, et al., 2017; Lam et al., 2021; Salvador, 2011).

1.3. Science Parks and the attraction of talents

In the literature, Science Parks are seen as drivers for converting scientific research into technological innovation as they ‘can provide the catalytic incubator environment for the transformation of “pure” research into production’ (Westhead, 1997, p. 46). Recent developments have led the concept of Science Parks away from its academic origins toward a view that sees them as seedbeds of innovation ventures (Lamperti et al., 2017; Squicciarini, 2009) and attractors of technology-based firms and skilled professionals (Guadix et al., 2016).

The influence of firms’ physical and organisational capital resources on competitiveness has diminished due to technological advances that have increased the speed and efficiency of information disclosure. That is, human capital has become a differentiating element and the main driver of a firm’s competitiveness (Alnidawi et al., 2017; J. Barney, 1991; Holland et al., 2007).

Moreover, the level of maturity of firms implies different human resource needs. This thesis does not define the maturity level of a firm in terms of firm size (Bulan and Yan 2010) but in terms of (i) the number of years of operation (Gilley et al., 2004), (ii) the ability to manage external resources (Davidsson & Klofsten, 2003), and (iii) the development level of the business platform (Klofsten, 1994). Whereas mature firms look for innovative ideas to improve their production processes, which is accomplished by hiring young-minded professionals such as university students (Klofsten & Jones-Evans, 1996; Lamperti et al., 2017), younger firms often lack managerial or technical competence in the team (Bøllingtoft & Ulhøi, 2005; De Cleyn et al., 2015), and need to recruit professionals with specific skills such as IT personnel, managers, and CEOs (De Cleyn et al., 2015; Zhu & Tann, 2005). Furthermore, young firms often have a limited network of contacts, making it challenging for them to find the necessary professionals (De Cleyn et al., 2015). In fact, lack of maturity can make it challenging to identify what skills they lack.

1.4. Exemplifying talent attraction activity at a Science Park

Lindholmen Science Park (LSP) in Gothenburg was founded in 2000 and is closely located to Chalmers University of Technology and the University of Gothenburg. LSP has about 350 firms and 11 000 employees, and its main competence areas are transport, ICT, and media industries. In 2013, Geely Auto, a Chinese firm, started a centre for future cars – China Euro Vehicle Technology (CEVT) – as a joint R&D centre with Volvo Cars at LSP. This new centre intends to develop vehicle modules and components that can be used by Geely Auto and Volvo Cars, companies that belong to the Zhejiang Geely Holding Group. In 2020, CEVT employed around 2000 workers.[2]

Interviews with the LSP's CEO made it evident that the CEVT had special features making it worthy of further investigation: the CEVT involves two countries with totally different cultures (i.e., China and Sweden); the CEVT involves two car manufacturers with distinct histories (i.e., Geely Auto and Volvo Cars); and the CVET has a special workforce (i.e., a mix of Swedish and Chinese workers who have moved to live and work in Sweden). To welcome CEVT and create favourable conditions for a long-lasting presence in Sweden, LSP focused on creating a stable situation regarding the recruitment and development of a competent workforce. The Science Park provided network services that help integrate CEVT workers into the Swedish system, including immigration assistance, housing, schools, networks, and contacts with the Swedish bureaucracy. LSP also brought the

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[2] https://www.cevt.se/who-we-are/#management

CEVT and Swedish universities closer together to make the recruitment of students and researchers more straightforward, to establish research links, and to transfer more effectively knowledge and technology. The CEVT case demonstrates how a Science Park could be attractive, creating a suitable environment for the settling foreign professionals and for the development of a large firm, which usually is less dependent on park support.

1.5. Knowledge gaps

Researchers, park managers, and policymakers have a strong interest in Science Parks as promoters of innovation, entrepreneurship, and regional development. However, studies often address the more traditional services offered to tenant firms, and their analyses are usually based on the contribution that Science Parks make to the development and success of their firms and typically only from the perspective of the firms receiving the services (Gwebu et al., 2018; Lindelöf & Löfsten, 2003; Monck et al., 1998; Ramírez-Alesón & Fernández-Olmos, 2018; Westhead, 1997).

Therefore, there are potential gaps in knowledge regarding other forms of support services provided by Science Parks besides those popularly known and disseminated. The processes developed by Science Parks to attract talent to facilitate corporate human resource management are rarely explored in the literature (Bellavista & Sanz, 2009; Roldan et al., 2018), and even fewer analyses consider the perspective of park management (supply-side) rather than park tenants firms and their entrepreneurs (demand-side) (Albahari et al., 2011, 2019). That is, two knowledge gaps were identified: the mechanisms through which Science Parks support tenant firms and the perspective frequently adopted in studies conducted on Science Parks.

Science Parks are tools in an economic development environment (Luger & Goldstein, 1991; Poonjan & Tanner, 2019). They facilitate firm-university connections (Colombo & Delmastro, 2002; Felsenstein, 1994; Fukugawa, 2006; Minguillo & Thelwall, 2015; Vedovello, 1997; Westhead & Storey, 1995) and provide business consulting and the infrastructure firms need to operate (Albahari et al., 2019; Colombo & Delmastro, 2002; Monck et al., 1998). In addition, Science Parks provide complementary advantages such as meeting places and leisure and green areas, which contribute to creating an ideal location for the development of firms. However, the portfolio of activities performed by Science Parks is much more extensive than usually presented in the literature and other ways of supporting firms have been developed and practised. With business globalisation and rapid access to information, knowledge has become a firm's primary asset, an understanding that recognises the value of skilled workers (Alnidawi et al., 2017; J. Barney, 1991; Holland et al., 2007). Thus, knowledge of the factors that influence the planning and execution of talent attraction activities needs to be deepened and better understood.

Some studies compare the performance of firms inside and outside Science Parks (Link, 2016; Löfsten & Lindelöf, 2002; Massey et al., 2003; Schiavone et al., 2014). Other studies focus on how firms perceive the benefits of the services offered by Science Parks and how such benefits influence the development and success of the firms (Díez-Vial & Fernández-Olmos, 2017; Sadeghi & Sadabadi, 2015).

The vast majority of studies that assess the benefits offered by Science Parks collect and analyse data from the perspective of tenant firms that are the recipients of park support services (Díez-Vial & Fernández-Olmos, 2017; Löfsten & Lindelöf, 2002; Monck et al., 1998). Therefore, these studies evaluate only the processes developed by Science Parks that directly target a particular firm or group of firms. In addition, as firms can evaluate only the result of these processes, these studies can report only the firms' perception of what was delivered to them. When analysing the activities developed by Science Parks only from the perspective of the service recipients, studies miss the opportunity to assess the collective progress and how much each process contributed, directly or indirectly, to the growth of the Science Park as a whole. In fact, the success of Science Parks is strongly correlated with the success of each tenant firm, but the reverse is not always true.

When it comes to talent attraction processes developed by Science Parks, studies become even more scarce (Bellavista & Sanz, 2009; Roldan et al., 2018). Talent attraction activities do not necessarily focus on supplying the needs of a particular firm or group of firms directly but may aim to strengthen the Science Park brand and make the environment more attractive for talent and firms (Cadorin, Johansson, et al., 2017; Lam et al., 2021; Salvador, 2011).

Therefore, this research project adopts the perspective of the Science Park (organisational level) rather than the perspective of individuals or tenant firms (individual or firm level) to cover this little-explored gap in the Science Park and talent attraction literature.

1.6. The aim and the research questions

This study analyses the development of Science Parks from the perspective of park management's activities that relate to attracting talent. Potential knowledge gaps in the Science Park literature provide the basis for formulating the objective of this thesis:

To explore how Science Parks plan and perform activities to attract talent to the park and its tenant firms.

Science Parks have undergone several transformations over the years, moving from a land-oriented organisational model to becoming a more interactive organisation with much more complex roles and relationships (Etzkowitz & Zhou, 2018). In this new scenario, Science Parks need to provide, in addition to space and infrastructure, mechanisms and opportunities for firms to capture knowledge, technology, and talent from the local university (Bellavista & Sanz, 2009; Roldan et al., 2018).

Talents are individuals who have the skills, knowledge, creativity, professional competence, communication, and leadership ability (Saddozai et al., 2017) that make them capable of adding value to a firm, leading it to a higher level of performance (Mcdonnell et al., 2017; Thunnissen et al., 2013). Therefore, talent can be considered one of the critical resources needed for the development and growth of firms (Alnidawi et al., 2017; J. Barney, 1991; Holland et al., 2007).

In fact, studies have found a positive correlation between the performance levels of tenant firms and informal connections and talent mobility (Hu, 2008; Schweer et al., 2012). Moreover, this correlation is a result of proximity to a local university and the industrial region as well as the activities performed by Science Parks (Kakko, 2012). Although there is a vast literature on Science Parks (see literature review in Poonjan & Tanner, 2019) and the importance of attracting talent is unanimous among researchers and park managers, little is known about these talent attraction activities that take place in Parks (Koh et al., 2005). Therefore, it is crucial to understand how Science Parks organise talent attraction activities and whether these activities are conducted in collaboration with local actors. Hence, the first research question is as follows:

RQ1: How do Science Parks organise talent attraction activities, either on their own or in collaboration with stakeholders?

Science Parks provide services that firms find difficult to offer internally in collaboration with other stakeholders. They build a network with tenant firms, universities, and research centres, supporting the exchange of knowledge (Albahari et al., 2017) and the talent attraction processes (Cadorin et al., 2021).

Universities play an essential role in the economic and social development of the regions in which they are located (Huffman & Quigley, 2002; Mellander & Florida, 2011; Youtie & Shapira, 2008). Places close to world-class universities, such as Silicon Valley, Singapore, and Cambridge, are often sources of technology start-ups, mainly because having access to knowledge and talented professionals and students is a determining factor in developing innovative businesses and products (Cooke, 2007). Universities are the primary source of talent, providing a steady flow of graduating students (Cai & Liu, 2015; Cowling & Lee, 2017; Etzkowitz, 2008; Florida, 1999; Kusmana, 2019). Therefore, creating informal and formal cooperation with universities is a necessary and crucial decision for developing a Science Park and its tenant firms (Berbegal-Mirabent et al., 2015; Cadorin et al., 2019; Hu, 2008).

Also, considering that most Science Parks firms are technology-based, they rely on reaching qualified professionals. Thus, new studies on Science Parks have begun to address issues related to their ability to develop solutions that can attract talent to their tenants (Bellavista & Sanz, 2009; Chen & Yu, 2008; Roldan et al., 2018). Therefore, it is crucial to identify and qualify the types of interactions and collaborations occurring between Science Parks and their stakeholders (such as nearby universities) and to understand their influence in the planning and execution of the talent attraction activities undertaken by Science Parks. The second research question addresses this subject:

RQ2: How does collaboration with stakeholders influence Science Parks planning for talent attraction activities and their performance?

Furthermore, efficient talent management practices can improve a firm's performance, and the activities of Science Parks can have a positive effect on a firm's performance (Huang et al., 2012; Löfsten & Lindelöf, 2002; D. S. Siegel et al., 2003; Squicciarini, 2008, 2009; Vásquez-Urriago et al., 2014).

Indeed, talent-related activities developed by Science Parks can be tools to improve the performance of tenant firms. Talent management practices, which include attracting, selecting, developing, and retaining talent (Heinen & O'Neill, 2004; Mcdonnell et al., 2017; Thunnissen et al., 2013), can create a competitive advantage for tenant firms (Ashton & Morton, 2005; Heinen & O'Neill, 2004). Science Parks should tailor talent activities to the needs of tenant firms. For example, start-ups need support that protects them from the high risk of failure during their first few years of operations (Bergek & Norrman, 2015).

Because Science Parks involve relationships with a large number of actors, it is essential to recognise policy implications that guide the creation of formal and informal networks of interactions. Indeed, policy implications generated by studies help all those involved in Science Park development improve their planning and actions and stimulate their growth (Albahari et al., 2019; Harper & Georghiou, 2005; Vedovello, 1997).

Finally, this thesis aims to propose recommendations for improving policies that will allow park managers to create a steady inflow of talent into the Science Park and researchers to develop studies to deepen knowledge on Science Park development and talent attraction activities. The third research question addresses this aim.

RQ3: What are the implications of the research findings on Science Park talent attraction activities for research and practice?

Table 1 presents how the three research questions are correlated to the five papers that form this thesis. The "X" means that the research question was treated in the paper. Research Question 1 was addressed in Papers 1, 2, and 3, and Research Question 2 was addressed in Papers 3, 4, and 5. Finally, Research Question 3 was discussed in all five papers. Papers 1, 2, and 3 were qualitative case studies aimed at uncovering a deeper understanding of the talent activities undertaken by Science Parks. Papers 4 and 5, quantitative analyses of an international survey, were aimed at complementing the knowledge gained from case studies by seeking to understand how stakeholders and talent characteristics influence performance and Science Park talent activities.

Table 1 – *Relation between research questions and papers*

Research questions	**Papers** **(See the list below)**				
	1	2	3	4	5
RQ1: How do Science Parks organise talent attraction activities, either on their own or in collaboration with stakeholders?	X	X	X		
RQ2: How does collaboration with stakeholders influence Science Parks planning for talent attraction activities and their performance?			X	X	X
RQ3: What are the implications of the research findings on Science Park talent attraction activities for research and practice?	X	X	X	X	X

Paper 1: Cadorin, E., Johansson, S. G., & Klofsten, M. (2017). Future developments for Science Parks: Attracting and developing talent. Industry and Higher Education, 31(3), 156–167.

Paper 2: Cadorin, E., Klofsten, M., Albahari, A., & Etzkowitz, H. (2020). Science Parks and the attraction of talents: activities and challenges. Triple Helix, 6(1), 36–68.

Paper 3: Cadorin, E., Germain-Alamartine, E., Bienkowska, D., & Klofsten, M. (2019). Universities and Science Parks: Engagements and interactions in developing and attracting talent. In Developing Engaged and Entrepreneurial Universities (pp. 151–169). Singapore: Springer.

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Paper 5: Löfsten, H., Klofsten, M., & Cadorin, E. (2020). Science Parks and talent attraction management: university students as a strategic resource for innovation and entrepreneurship. European Planning Studies, 28(12), 2465–2488.

1.7. Relevance

Most existing studies analyse Science Park activities from the perspective of tenant firms by trying to understand how these firms perceive the value of the support received (Lindelöf & Löfsten, 2003; Squicciarini, 2009; Vasquez-Urriago et al., 2016; Vásquez-Urriago et al., 2014). Therefore, in adding to the academic literature in this area, this study adopts a Science Park perspective (supply-side) and includes the attraction of talent as an essential element among the mechanisms adopted by Science Parks to generate value for tenant firms.

For practitioners, this study will help Science Park managers understand how and why they should optimise their activities to strengthen meaningful relationships such as with the government, local university, and student communities. This study also proposes to all those involved in the management and development of Science Parks how to support, in matters of talent, mature firms, which are often self-sufficient, and growing firms, which are usually more dependent on external support.

1.8. Summary

Science parks support the emergence and development of technology-based firms, which depend heavily on access to skilled workers by providing infrastructure and services (Colombo & Delmastro, 2002; Díez-Vial & Montoro-Sanchez, 2017). Analysing the literature on Science Parks development, two potential gaps in knowledge were identified: the mechanisms through which Science Parks support tenant firms and the perspective frequently adopted in studies conducted on Science Parks. These gaps provide the basis for formulating the objective of this thesis, which is to explore how Science Parks plan and perform activities to attract talent to the park and its tenant firms.

2. LITERATURE REVIEW

This chapter reviews the literature relevant to this thesis, starting with an overview of how the literature defines Science Parks, including their characteristics, structures, processes, and stakeholders. Then, a literature review is conducted, addressing definitions and characteristics associated with talent. Next, the support activities developed by Science Parks are contextualised within the scope of attracting talent. The literature is also examined to understand the factors that contribute to improving the performance of Science Parks. Finally, a proposal for a research model is detailed.

2.1. Science Parks definitions

The literature provides neither a widely accepted definition of Science Parks (Fukugawa, 2006; Hobbs et al., 2017) nor a clear understanding of their role in the region where they are located (Almeida et al., 2020). Also, several terms are used to indicate the types of parks, such as Science and Technology Parks, Research Parks, Innovation Parks, Innovation Centres, and Business Parks (Monck et al., 1998; Rowe, 2014). Also, Albahari et al. (2017) categorise Science Parks into four types: i) pure Science Parks, where a university is the principal owner; ii) Mixed Parks, where a university is a minority part-owner; iii) Technology Parks with a university, where the university is not a shareholder but has facilities at the park; and iv) Pure Technology Parks, where there is no university formally involved.

In addition, Escorsa and Valls (1996) note some differences between Research Parks, Technology Parks, and Science Parks regarding their operational focus and the presence of research institutions. According to these authors, Research Parks use teaching and research institutions to bring the academy closer to applied research without focusing on the development of new products and markets. Technology Parks focus on the generation of high-tech commercial products and do not consider the existence of a teaching or research centre to be relevant. Finally, Science Parks benefit from the presence of universities or research centres as they help generate and develop knowledge-based firms.

For Guadix et al. (2016), Science Parks, unlike other parks, have detailed policies for selecting tenant firms, participate in technology transfer processes, cooperate with actors from the public and private sectors, provide commercial support services, and offer incubators.

The location where the Science Parks are being studied also influence how they are named. Europe, Asia, and the United States typically use the terms Science, Technology, and Research, respectively, to refer to such parks. In addition, these regions have different relationships with Science Parks. In the United States, public sector involvement is usually indirect and focused on university research. In several Asian countries, government involvement is straightforward. In the United Kingdom, Science Parks are located very close to universities, whereas in the United States the distance between a Science Park and the university can vary since the space required is not always available nearby (Link & Scott, 2018).

Albahari et al. (2010) found that the definitions of Science Parks commonly found in the literature are derived from three specialised organisations: the Association of Universities and Research Parks (AURP), the International Association of Science Parks and Areas of Innovation (IASP), and the United Kingdom Science Parks Association (UKSPA). These three definitions (see Table 2) provide insights into how practitioners view the organisation and purpose of Science Parks.

The common point in the definitions of the Science Park associations is that they all consider Science Parks to have infrastructures that facilitate innovation and promote the exchange of knowledge, with the university being one of the motivators of these interactions (Hobbs et al., 2017).

Table 2 – Definitions from Science Park associations

Organisation	Definition
AURP	"University Research Parks are physical environments that can generate, attract, and retain science and technology firms and talent in alignment with sponsoring research institutions that include universities, as well as public, private and federal research laboratories. Research Parks enable the flow of ideas between innovation generators such as universities, federal labs, and non-profit R&D institutions and firms located in both the Research Park and the surrounding region" (AURP, 2017).
IASP	"A Science Park is an organisation managed by specialised professionals whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology amongst universities, R&D institutions, firms and markets; it facilitates the creation and growth of innovation-based firms through incubation and spin-off processes; and provides other value-added services together with high-quality space and facilities" (IASP, 2017).
UKSPA	"A Science Park is a business support and technology transfer initiative that: encourages and supports the start-up and incubation of innovation-led, high-growth, knowledge-based businesses; provides an environment where larger and international businesses can develop specific and close interactions with a particular centre of knowledge creation for their mutual benefit;

	has formal and operational links with centres of knowledge creation such as universities, higher education institutes and research organisations" (UKSPA, 2017).

Finally, due to many definitions in the literature and the difficulty in having a widely accepted definition, this study uses the different definitions of Science Parks in the academic literature to define Science Parks. Here, Science Parks are understood to have a management team committed to stimulating innovative businesses and supporting the growth of tenant firms by offering physical resources, business advice, and services related to financial and marketing and connections with knowledge-generating institutions, such as universities and research centres to facilitate the transfer of technology and skilled human resources (Almeida et al., 2020; Colombo & Delmastro, 2002; Diez-Vial & Fernández-Olmos, 2017; Gyurkovics et al., 2014; Hansson, 2007; Monck et al., 1998).

2.2. Science Parks characteristics

Science Parks are policy-driven organisations (Huang et al., 2012), and their proliferation around the world is due to governments considering parks as a technology and innovation policy tool (Albahari et al., 2017; Squicciarini, 2008). Thus, since they are created in this planned and motivated way, the analysis of their characteristics is favoured, which would be more challenging to do with spontaneous agglomerations (Albahari et al., 2018).

The literature notes that age and size are usually associated with organisational performance (Blau, 1970; Huselid, 1995; Lu et al., 2015). Moreover, the creation date and physical size of Science Parks are easily ascertained. Park size is correlated with the number and maturity of tenant firms and the number of employees (Albahari et al., 2018; Autio & Klofsten, 1998).

Another characteristic that differentiates parks from other agglomerations is the presence of a management team that actively handles the park's activities (Albahari et al., 2018, 2019; Löfsten & Lindelöf, 2002). Indeed, an experienced and committed management team is usually associated with successful Science Parks (Albahari et al., 2018; Cabral, 1998; Löfsten & Lindelöf, 2002).

Albahari et al. (2018) correlate the age and the management team of parks; that is, due to accumulated knowledge, managers of older Science Parks can better understand the needs of tenant firms, so they can offer better support activities for tenants. In addition, Albahari et al. (2018) point out that the impact of business support takes time before it can be assessed and measured. It is worth highlighting that, considering the long term, there is a risk of stagnation of learning and accommodation in the execution of activities, which could decrease performance (Durand & Coeurderoy, 2001).

Moreover, considering that parks are tools for developing innovation and technology and are geographically delimited, their location is also a relevant characteristic. In technologically developed regions, firms can find the connections and resources necessary for their development outside the Science Park; however, competition is more significant in these areas. On the other hand, in remote regions, the support of Science Parks is more critical for tenant firms, and they tend to stand out from local competitors as competition is reduced (Albahari et al., 2018; Felsenstein, 1994).

A park's proximity to universities and research centres means that a park will likely specialise in the same areas of knowledge as this approach will increase opportunities for knowledge creation and acquisition (Link & Scott, 2018), knowledge spill over, and specialised labour recruitment (Albahari et al., 2019). Studies (Hu, 2008; Poonjan & Tanner, 2019) also point out that the proximity of Science Parks to universities and research centres increases the interaction between high-tech professionals and expands their professional networks. Moreover, the proximity between tenants often encourages interactions, positively influencing performance (Beaudry & Swann, 2009; McCann & Folta, 2011; Silva et al., 2020), although they can perceive this influence to different degrees (Jonsson, 2002).

Arthur (1990, p. 237) notes that the 'benefits to being in a location together with other firms increase with the number of firms in the location'; moreover, as the number of tenants increases, knowledge and social capital increase (Albahari et al., 2018), further attracting new firms and new talent. However, this effect only occurs once a certain threshold has been reached, and the effect might even diminish if the agglomeration becomes too large (Bakouros et al., 2002; Folta et al., 2006).

2.3. Structure and processes of Science Parks

Several studies analyse the effectiveness of Science Parks in promoting tenant firm's growth. Some authors argue that there are no benefits for tenant firms in comparison with off-park firms (Colombo & Delmastro, 2002; Löfsten & Lindelöf, 2002; e.g. Westhead, 1997). Other authors, however, perceive Science Park as drivers of innovation (e.g. Squicciarini, 2008, 2009; Vásquez-Urriago et al., 2014; Yang et al., 2009) as they can provide adequate structure and process for connecting tenants and academia, which facilitate contacts and partnerships that would be more difficult for firms to achieve on their own (Albahari et al., 2018; S. Gower & Harris, 1996; S. M. Gower & Harris, 1994; Vedovello, 1997).

Indeed, the innovation environment found in Science Parks (Albahari et al., 2018) promotes the transformation of a university's scientific research into innovative products developed by tenant firms (Díez-Vial & Montoro-Sánchez, 2016; Westhead, 1997). Furthermore, these cooperative interactions that promote innovation occur between

Science Park firms and the university, and between tenant firms (Bakouros et al., 2002).

Previous research on the methods used to promote the growth and development of enterprises (including those related to Science Parks) highlights the need to support firms with both configuration and process-oriented resources (Albahari et al., 2019; Autio & Klofsten, 1998).

Configuration-oriented support, a static business support design (see Autio & Klofsten, 1998), includes offering attractive infrastructure, reinforcing the Science Park's brand, and increasing funding availability (Albahari et al., 2019). The Science Park brand, built mainly through social networks and the internet, is one of the main values Science Parks provide tenants (Cadorin, Johansson, et al., 2017; Lam et al., 2021; Salvador, 2011) and helps attract new tenants and talent (Dabrowska, 2011; Felsenstein, 1994). A Science Park's reputation potentially increases the availability of funds as it facilitates the identification of high-quality firms. Thus, the screening activity of investors is optimised, and the risk these investors perceive is reduced. (Albahari et al., 2019; Schiavone et al., 2014).

Process-oriented support is related to offering a range of activities and services. Because Science Parks host firms of different ages, maturity and business orientations, the support the firms receive needs to address the firms' specific needs. In general, the services a Science Park provides communicates what it values and address the real needs of entrepreneurs. These services can be grouped into three broad categories: incubation, training, and networking (Albahari et al., 2019). Incubation assists firms during their first months of existence, training helps entrepreneurs develop their business ideas, and networking facilitates collaboration with strategic actors in the park.

2.4. Science Parks stakeholders

The connections and relationships with the actors of the triple helix model (see Leydesdorff & Etzkowitz, 1996) are central to the concept of Science Parks (Albahari et al., 2019; Cadorin et al., 2021; I. Guy, 1996; Quintas et al., 1992). For example, links between firms and universities are essential for the training of employees (Kesting et al., 2014; Vedovello, 1997), for the development of entrepreneurial spirit among university students, and for the exchange of knowledge and technology between academia and commercial applications (Autio et al., 2018).

Some students and researchers go beyond university boundaries and create start-ups in Science Parks (Díez-Vial & Montoro-Sánchez, 2016; Franklin et al., 2001). These academic entrepreneurs need business advice to help them develop their ventures (Albahari et al., 2018; Cadorin, Johansson, et al., 2017; Franklin et al., 2001), physical and virtual collaboration platforms to promote open innovation and community extension principles (Kakko, 2012), and adequate business facilities (Etzkowitz & Klofsten, 2005; Franklin et al., 2001; Lamperti et al., 2017; Walcott, 2002) such as small and inexpensive offices, incubators, and co-working spaces, to accommodate their growth (Rowe, 2014). Science Parks usually provide these essential resources (Albahari et al., 2018; Huffman & Quigley, 2002), and the proximity to a university keeps academic entrepreneurs close to their origins, motivating the relationships between the new firm and the university and facilitating ongoing interaction (Díez-Vial & Montoro-Sánchez, 2016; Etzkowitz & Zhou, 2018).

The local business ecosystem found in Science Parks stimulates tenant firms to build collaborative networks with the local university and other firms (Phillimore, 1999; Silva et al., 2020) and attract talented employees (Hu, 2008; Schweer et al., 2012), which are essential in developing innovative products. Other Science Parks in the region and off-park firms can also influence a Science Park as well as be influenced by a Science Park (Albahari et al., 2019; Marinazzo, 1996).

Furthermore, Science Parks do not operate in isolation, nor are they concerned only with their internal relationships (Etzkowitz & Zhou, 2018). On the contrary, several actors outside a Science Park need to be considered, whether in academic, industrial, or governmental sectors (regional, national, and international). Indeed, the local government is an essential stakeholder in the relationship network because Science Parks rely on public infrastructures such as transportation, housing, schools and medical facilities (Etzkowitz & Zhou, 2018). Federal government authorities play an essential role in directing how Science Parks will be developed, which influences the selection of tenant firms as well as the projects pursued (Biswas, 2004). At the international level, embassies can contribute to the internationalisation of a Science Park's brand and financial institutions (both public and private) can provide the necessary financial resources to develop projects in a Science Park (Marinazzo, 1996; Silva et al., 2020).

Finally, because of this variety of actors, individual interests need to be considered, and each actor needs to work towards a common goal. On the government side, economic growth and technological development through innovation are highly coveted (Silva et al., 2020). Universities desire the results of their research to reach the market whether through patents or technology licensing (Poonjan & Tanner, 2019). Indeed, a university's links with neighbouring tenant firms facilitate the application of academic knowledge in commercial solutions (Karlsson & Wigren, 2012). Firms and entrepreneurs connect with universities to find projects with potential for commercialisation and a quick return, and these relationships are the expected synergies that will make a Science Park successful (Jonsson, 2002).

2.5. Talent

Qualified professionals are the main factors for determining whether a firm is competitive and ultimately survives (Alnidawi et al., 2017; J. B. Barney, 1995; Holland et al., 2007). When professionals have, in addition to their experiences and specific qualifications (Gagné, 2004; Saddozai et al., 2017), the motivation to perform at the highest level, achieving remarkable results, we say that this person is a talent for a firm (Collings & Mellahi, 2009).

Literature addresses talents from two perspectives: objects and subjects (Gallardo-Gallardo et al., 2013). Objects refer to personal characteristics, including 'ability, capacity, capability, commitment, competency, contribution, experience, knowledge, performance, and potential, patterns of thought, feeling or behaviour, and skills that are related to the characteristics of people' (ibid., p. 293). Subject refers to an elite subset of workers in a firm.

Although there is no precise definition of what constitutes talent (Lewis & Heckman, 2006; Thunnissen et al., 2013), Gallardo et al. (2013) define talents as professionals who already deliver exceptional results (high-performing talents) or are capable of moving faster than their peers (high-potential talents), while presenting different demands, motivations, and behaviours compared to regular workers. Saddozai et al. (2017) assert that talents have skills, knowledge, creativity, professional competence, communication, and leadership ability, whereas Thunnissen, Boselie and Fruytier (2013) and Mcdonnell et al. (2017) highlight the ability of talent to add value to a firm and boost its performance. Furthermore, the organisational environment in which professionals perform their activities strongly influences the results obtained and the talent development process (Gagné, 2004; Gallardo-Gallardo et al., 2013). Moreover, it is not possible to establish a direct correlation between previous success and expected future performance when working conditions are not similar (Thunnissen & Van Arensbergen, 2015).

2.6. Talent characteristics

Meyers et al. (2013) describe talent as having a continuous spectrum, ranging from totally innate to fully acquired throughout life. The authors also present five main characteristics of talents found in the literature: giftedness, strength, (meta) skills, high potential, and high performance. Talents have specific experiences and abilities and are often interested in developing the firm's culture, networks, and organisational structure (Gagné, 2004; Saddozai et al., 2017). In addition to performance, professionals need to have outstanding qualifications to be considered a talented person (Thunnissen & Van Arensbergen, 2015). Therefore, potential talents such as recent graduates, junior researchers, and novice professionals desire to improve their skills so they can become more valuable to firms (Papademetriou et al., 2008).

In summary, talent skills comprise potential, performance, creativity, competence, and leadership abilities (Saddozai et al., 2017) as well as commitment and willpower to use these skills to achieve above-average results (Gagné, 1985; Gallardo-Gallardo et al., 2013; Saddozai et al., 2017; Tansley, 2011). According to the literature (Gallardo-Gallardo et al., 2013; Saddozai et al., 2017; Tansley, 2011; Tansley & Kirk, 2017; Thunnissen & Van Arensbergen, 2015), the talents' main characteristics are correlated with their knowledge, skills, experiences, creativity, leadership, ability to communicate and cooperate, and motivation to act (Table 3).

Table 3 – The main characteristics of talents

Characteristics	Examples
Science & Technology expertise	Scientific knowledge and academic proficiency
Business experience	Competencies, experience
Personal skills	Creativity and cognitive skills
Leadership	Leadership abilities
Social skills	Communication and cooperation skills
Behavioural aspects	Drive and motivation

2.7. Science Park talent attraction activities

Irrespective of the types of talent needed, younger and mature firms will benefit from talent attraction activities developed by Science Parks. On the one hand, young firms often lack technical or managerial skills and need to strengthen their staff (Bøllingtoft & Ulhøi, 2005; De Cleyn et al., 2015; Gilley et al., 2004), but their processes, including the hunt for professionals, tend to be immature, making this search a significant challenge. Indeed, young firms are described in the literature as being more dependent on support from a Science Park (Albahari et al., 2018; Zhu & Tann, 2005). When it comes to start-ups in their early years of development, this dependence is even more significant, and Science Park support can increase the chances of business success (De Cleyn et al., 2015). Lundqvist et al. (2014) claim that young firms that bring together entrepreneurs engaged in business development have a greater chance of better performance. Furthermore, the authors emphasise that incubators need to learn and apply effective methods to influence the formation of start-up teams.

On the other hand, mature firms have consolidated processes and therefore are less dependent on external support (Gilley et al., 2004). However, they desire to keep their products and production processes innovative enough to guarantee their competitiveness in the market. To accomplish this, mature firms need to hire people with fresh ideas who are commonly associated with young academics and university students (Klofsten & Jones-Evans, 1996; Kusmana, 2019). Such individuals are usually found in high concentration in Science Parks (Cheba & Hołub-Iwan, 2014; Ferguson & Olofsson, 2004; Gwebu et al., 2018; Holland et al., 2007; Rowe, 2014; R. Siegel et al., 1993)

Indeed, regardless of the firm’s maturity, understanding its need for talented workers and selecting the ones who are the best fit for a team has become essential for a firm’s survival (Cappelli, 2008; Thunnissen et al., 2013). This issue is a subject of debate in human resource literature (Boudreau & Ramstad, 2007; Collings & Mellahi, 2009; Lewis & Heckman, 2006). Talent management has gained relevance for firms (Mcdonnell et al., 2017), and its practices, which include attracting, selecting, developing, and retaining talent (Heinen & O’Neill, 2004; Mcdonnell et al., 2017; Thunnissen et al., 2013), are considered a crucial source of competitive advantage (Collings & Mellahi, 2009; Mcdonnell et al., 2017).

One of the inherent principles of Science Parks is supporting firms in accessing academic knowledge (Albahari et al., 2017; Lindelöf & Löfsten, 2005; Löfsten & Lindelöf, 2002). Science Parks establish communication channels with the local university to facilitate the training of firm workers and the recruitment of qualified labour from the academic environment (Chan & Lau, 2005; Drejer et al., 2021; Poonjan & Tanner, 2019; Vedovello, 1997). The opportunities for professional and personal development offered by Science Parks (Thunnissen et al., 2013) are not always easy for a firm to achieve independently (Younger et al., 2007).

In fact, promoting the exchange of knowledge (Díez-Vial & Montoro-Sánchez, 2016) and talents (Cadorin et al., 2019) between the local university and tenant firms is one of many activities performed by Science Parks. In this context, academic entrepreneurs can find in Science Parks the proper infrastructure (Albahari et al., 2019; Etzkowitz & Klofsten, 2005; Walcott, 2002; Westhead & Storey, 1995) and the business consultancy to make their ideas a reality (Huffman & Quigley, 2002; Rowe, 2014).

Therefore, the availability of an innovative environment, job opportunities in high-tech firms, as well as facilities that promote a high quality of life (Cadorin et al., 2020; Chan & Lau, 2005; Florida, 2002) enables Science Parks to help firms attract and retain talent. Finally, tenant firms have the possibility to build robust collaboration networks that make their talent management processes even more effective (Hu, 2008; Schweer et al., 2012).

2.8. Science Park performance

The literature notes that each Science Park has unique objectives, carries out activities in different ways, and interacts with a diverse set of stakeholders, which complicates the development of universal criteria that can be used to measure the effectiveness of Science Parks and therefore complicating any comparisons between Science Parks (Albahari et al., 2017, 2018; Liberati et al., 2016). In fact, this heterogeneity of characteristics makes measuring the park's performance or even inferring its level of success extremely problematic (Poonjan & Tanner, 2019).

To understand how Science Parks generate value for their tenants, studies suggest some indicators to measure the efficiency of Science Parks such as years of operation, R&D expenses, firms' gains linked to innovation, and relationships generated with local universities (Aaboen et al., 2008; Albahari et al., 2013; Guadix et al., 2016; W.-H. Lee &

Yang, 2000). A report from the European Commission (Rowe, 2014) recommends other indicators such as the total and built areas of the Science Park, the number of tenant firms, the number of skilled workers, and the quality of the jobs generated. Some authors also identify partner networks as impacting the performance of Science Parks (Bigliardi et al., 2006; E. K. Guy et al., 1996; Lam et al., 2021).

These indicators assess Science Park's performance from an intrinsic point of view related to technological synergy (product-related). Nonetheless, it is also possible to evaluate from an extrinsic perspective linked to economic development (impact-related). In addition, considering that Science Parks do not produce instant results, their success indicators (intrinsic or extrinsic) require some time to pass before they are evident (Comacchio & Bonesso, 2012; Hogan, 1996).

Moreover, the National Research Council (2009, p. 31) argues that a combination of five factors must exist in all Science Parks, although they do not guarantee success:

1. links with a university or research centre to support a critical mass of knowledge workers;
2. accessibility of funding over a sustained period;
3. a reliable and dedicated management team;
4. a physical infrastructure and quality-of-life amenities; and
5. talented and motivated individuals to produce and commercialise the knowledge generated.

In their study of three Science Parks, Koh, Koh, and Tschang (2005) identify two common success factors across parks: good access to talent and the ability to generate new technologies and products for worldwide markets. For example, the success of Silicon Valley is attributed to a series of competitive advantages, such as a broad set of technical talents, availability of pre-existing infrastructure and network of suppliers, available venture capital, excellent educational facilities and research institutions, and well-developed information networks that contribute to the formation of new firms (Amirahmadi & Saff, 1993; C.-M. Lee et al., 2000).

2.9. Research model

This study explores how Science Parks plan and perform activities to attract talent to a Science Park and its tenant firms. This study hypothesises that the characteristics of the desired talent and the Science Park's structure, processes, characteristics, and stakeholder relationships affect a Science Park's performance. In addition, the talent attraction activities developed by Science Parks act as mediators of this influence.

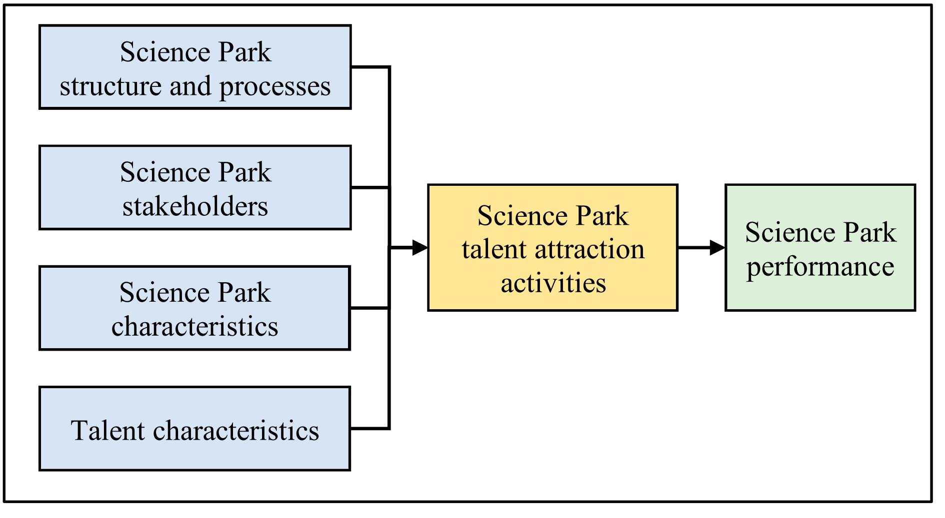

Figure 1 - *Research model: the effects of talent attraction activities on Science Park performance.*

First, the proposed research model (Figure 1) suggests that structure and processes of Science Parks are oriented towards configuration (attractive infrastructure, Science Park brand, and availability of funding) and processes (incubation, training, and networking) (Albahari et al., 2018; Autio & Klofsten, 1998).

Second, the Science Park's stakeholders considered in this study are the triple helix model actors (see Leydesdorff & Etzkowitz, 1996). The government provides public services such as transportation, housing, schools, and the health system; supports the Science Park's projects through public funding agencies and embassies; and demands innovative products (Cadorin, Johansson, et al., 2017; Laamanen & Autio, 1996; Marinazzo, 1996). The academy actor is the local university, which provides knowledge, technology, training, and talent (Poonjan & Tanner, 2019). The industry is embodied mainly by the tenant firms, incubators and start-ups, private financing firms, and even off-park firms in the region.

Third, the Science Park characteristics considered are age (year of establishment), size (number and maturity of its tenant firms and the number of employees), and location (region, proximity to universities and developed centres, and proximity between tenants) (Albahari et al., 2018; Autio & Klofsten, 1998; Ramírez-Alesón & Fernández-Olmos, 2018).

Fourth, the characteristics of the talents who are the targets of the Science Park attraction activities are science and technology expertise, business experience, personal skills, leadership, social skills, and behavioural aspects (Gallardo-Gallardo et al., 2013; Saddozai et al., 2017; Tansley, 2011; Tansley & Kirk, 2017; Thunnissen & Van Arensbergen, 2015).

Fifth, the talent attraction activities developed by Science Parks act as mediators in the research model and can be analysed in terms of the level of activity (i.e., whether the activities attract talent at the firm or individual level) or according to talent categories (i.e., activities that aim to attract talent as individuals or as a class of individuals) (Cadorin, Johansson, et al., 2017).

Finally, the Science Park performance is based on a set of indicators found in the literature: innovation results (number of patents, number of licenses, and number of R&D projects), the success of tenants, firm-academic links, firm-firm links, and the availability of talented and motivated individuals to produce and commercialise knowledge (Bigliardi et al., 2006; K. Guy, 1996; National Research Council, 2009; Rowe, 2014).

2.10. Summary

This study explores how Science Parks plan and perform activities to attract talent to a Science Park and its tenant firms. Although the literature on Science Parks is not conclusive in terms of the benefits offered to tenant firms and their characteristics, this study suggests a model to test the hypothesis that the characteristics of the desired talent and the Science Park's structures, processes, characteristics, and stakeholder relationships influence the Science Park performance as well as whether the talent attraction activities developed by Science Parks act as mediators of this influence.

3. METHODS AND DATA

This chapter describes the research process and the decisions that led to this thesis and discusses the plan and approaches applied to answer the proposed research questions. The summary of the papers is then presented, highlighting the division of the work. Finally, the validity and reliability of the results are analysed, and the methodological limitations are presented.

3.1. Research background

The preparation for this PhD course began in 2013 when I attended the first executive course in innovation management promoted by the Brazilian Army in partnership with Linköping University, SAAB, and the Swedish Armed Forces. At that time, the Brazilian Army was conceiving a Science Park as one of the pillars for the planning and operationalisation of its Science, Technology, and Innovation System. This new Science Park planned to be based on the interaction between academia, government, and industry actors, following the Triple Helix model, to stimulate research, innovation, and product development for the defence sector. Therefore, to create a new Science Park, the Brazilian Army would need people with knowledge about the development of Science Parks. After some studies and conversations, Brazil and Sweden signed a bilateral strategic cooperation agreement, which included some master and PhD courses at Linköping University.

In 2015, I joined the course and started studying Science Parks and talent attraction issues. During the course, my professional relationship as an officer in the Brazilian Army was maintained. The initial period of the course was intensely dedicated to attending to academic disciplines to deepen and expand the horizons of knowledge. Also, I started the necessary preparation for the first scientific article on Science Parks and talent attraction, "Future developments for Science Parks: Attracting and developing talent". This article was co-authored with Professor Magnus Klofsten, my course supervisor, and Mr Sten Gunnar Johansson, founder and former CEO of Mjärdevi Science Park (now named Linköping Science Park) for more than 30 years. This study was initially presented at the *High Technology Small Firms (HTSF) Conference on Technology-Based Entrepreneurship* in Liverpool and the *33rd IASP World Conference on Science Parks and Areas of Innovation* in Moscow (both in 2016). The article was published in the journal *Industry and Higher Education* at the beginning of 2017. This first publication confirmed that the research project was heading in the right direction, enabling me to continue my studies.

3.2. Research design

Nasser (2001) explains that a research design is a plan to answer the research questions proposed, and it should include a structure and strategy on what will be accomplished from the development of the hypotheses through the final analysis of data when the operational implications are identified. In addition, research designs must carefully select the most appropriate approaches for the study's final objective, and the choice should include the methodologies for data collection and the proper techniques for analysis. Bryman and Bell (2007) state that there are advantages and disadvantages in using different approaches simultaneously. Moreover, Jick (1979) and Johannessen (2009) recognise that there are gains in composing methodologies, mainly by avoiding problems related to bias, which is a common problem when using only one method.

The research design of this thesis was developed having initially a qualitative phase aimed at deepening the knowledge about Science Parks and talent attraction, and this was followed by a quantitative phase to expand and apply the qualitative phase results in a broader context. The qualitative phase identified a series of talent attraction activities that describe different aspects related to the characteristics of talent as well as related to the stakeholders, structures and processes of

Science Parks. The results of this phase supported the formulation of the questionnaire for the quantitative stage (Sieber, 1973; Tashakkori & Teddlie, 1998). Table 4 shows the focus of each phase of the research design.

Table 4 – *Phases of the research design*

Phase	Focus
Literature Review	Science Parks
	Talent attraction
Qualitative Case Studies	One Science Park and four cases
	Three Science Parks and seven cases
	One Science Park and one university
Quantitative Survey Studies	Stakeholder collaboration and talent characteristics
	Partnerships with students/alumni and universities/firms
Thesis	Compilation of the articles and analysis of the findings

The literature review preceded all phases and permeated the entire process until the writing of this thesis. The qualitative phase consisted of three studies. The first study considered one Science Park and four activities to attract talent. The second involved three Science Parks and seven talent attraction activities. The third undertook a more in-depth look at the relationship between Science Parks, the tenant firms, and the local university when attracting academic talent. Each of the three qualitative studies resulted in a scientific publication.

The quantitative phase began with planning a questionnaire and sending it to 120 European and Brazilian Science Parks. The survey encompassed economic, political, and cultural aspects, enabling an analysis of the development of Science Parks from the perspective of the activities carried out to attract talent. The quantitative phase resulted in two scientific papers.

3.3. Research approach

Strauss (1987) states that studies that adopt only one method are more exposed to problems such as those associated with the formulation of interview questions, biased or not entirely accurate answers. The author recommends an information triangulation approach to mitigate these risks.

Triangulation in social science was first discussed by Campbell and Fiske (1959), who believed that more than one method would guarantee the validation of a process. That is, the triangulation of information ensure valid results and not artificial products of a single method (Bouchard, 1976). Triangulation can also be applied internally by using various collection and analysis techniques to cross-reference the information obtained. However, cross-method triangulation is commonly used in research and is the one that produces the most reliable results. (Jick, 1979).

Easterby-Smith, Thorpe, and Lowe (1991) define four types of triangulation: i) triangulation of theories – the explanation of a phenomenon comes from a theory of another field of research; ii) data triangulation – data collection occurs at different times or from different sources; iii) researcher triangulation – data collection is carried out independently by different researchers; iv) methodological triangulation – the analysis of the collected data makes use of quantitative and qualitative methods.

This research explains the influence of talent attraction activities in the development of Science Parks by adopting a methodological triangulation approach that uses the qualitative phase to develop hypotheses, which are embodied in the proposed model, to be tested in the regressions analysis of the quantitative phase (Kaplan, 2015).

This thesis uses a qualitative approach to collect data from three Swedish Science Parks. These data were used to build the theoretical frame (Yin, 2003) for Science Parks and talent attraction activities. Then, a quantitative approach was used to test the hypotheses developed during the qualitative phase and to identify causal relationships between the variables (Hart, 1998) of the international Science Park survey. Moreover, Kaplan (2015) states that surveys can validate or contextualise observations derived from cases studies.

Table 5 – *Aim and research approach of the papers.*

Paper	Aim	Research approach
1	To explore activities developed by Science Parks to stimulate the attraction of talent.	Qualitative approach: Longitudinal case study on a Swedish Science Park through interviews and secondary data. Interactive research approach.
2	To examine how Science Parks collaborate with stakeholders to attract talent.	Qualitative approach: In-depth case study on three Swedish Science Parks through interviews and secondary data. Interactive research approach.
3	To map types of interactions and engagements occurring between Science Parks and their adjacent university to	Qualitative approach: Literature review and descriptive cases to illustrate the findings from the literature.

	attract talent discussed in the literature.	
4	To investigate how collaborations between Science Parks and their stakeholders attract talent.	Quantitative approach: International survey of 59 European and Brazilian Parks.
5	To investigate how talent attraction management were developed by Science Parks to build successful partnerships with students and alumni and universities and firms.	Quantitative approach: International survey of 59 European and Brazilian Parks.

3.3.1. Qualitative approach

The first three studies of this research project were carried out applying a qualitative methodology to deepen the knowledge of activities undertaken by Science Parks aimed at attracting talent. The literature review for composing the cases covered studies on Science Parks, defined by academia and park associations, and talents, which are considered either an individual (subject) or individual characteristics (object).

The decision to use case studies was based on the understanding that this method is the most suitable for investigating contemporary phenomena immersed within a real-life context, especially when it is not easy to distinguish the studied phenomenon from the background (Yin, 2003). In addition, Eisenhardt and Graebner (2007) credit enormous relevance in this methodology in terms of connecting precious qualitative evidence with traditional deductive research. Also, Eisenhardt (1989) suggests that researchers should use an iterative working process when comparing empirical data with theory.

The case studies in the three Swedish Science Parks were constructed based on interviews with key people and considering the existing context behind the analysed events (Gioia et al., 2013; Yin, 2003). Furthermore, comparing the facts observed in the case studies with the academic literature, new hypotheses emerged about the different circumstances in which talent attraction activities can occur in Science Parks.

The first study addresses the Mjärdevi Science Park (MSP), now Linköping Science Park, because during its over 30 years of operation. MSP has had some successes and some failures attracting talent. In addition, Linköping University maintains solid connections with its management team, ensuring reliable access to information.

A longitudinal case study was then conducted on the motivations and activities related to attracting talent to MSP. The MSP development timeline was subdivided into four phases: inception, start-up and early development, expansion and development, and continuous growth and development. The objectives and stakeholders of all phases were highlighted, and the talent cases that were built illustrate different aspects related to talent attraction.

In addition, Mr Sten Gunnar Johansson, founder and former CEO of MSP, participated as an active observer and provided this research project with detailed information on the development of MSP, from before its founding in 1984 until 2014 when he left the park management. In addition, one interview was conducted with the CEO of the LEAD business incubator to enrich information about processes developed by the incubator team that related to attracting talent. Secondary data were collected from associated scientific papers and institutional documentation. In accordance with the research questions, longitudinal analysis of the concepts identified in each phase included grouping and organising the concepts into patterns of activities related to talent attraction (see Gioia et al., 2013). Finally, the cases were validated by people who were not involved in the data collection process but had actively participated in the development of MSP.

The second study encompasses two additional Swedish Science Parks – Ideon Science Park (ISP) and Lindholmen Science Park (LSP) – with seven talent cases. These three Science Parks shared similar characteristics such as age, orientation, and location (i.e., they are in the same country and therefore share the same legislation and culture).

The data were collected through semi-structured interviews with a panel of key individuals, including former and current CEOs, incubator managers, and Science Park management members who are project leaders of talent activities. The interviews were designed to identify potential talent cases, gather historical information, validate the data, and receive feedback on the study's design (Florin et al., 2007). Furthermore, this study adopts the Science Park perspective (supply-side), so no employees of the tenant firms were interviewed (demand-side). The interviews were conducted in 2015 and 2016 and comprised of 13 personal interviews lasting around 25 hours. In addition, some respondents had three follow-up telephone interviews lasting between 15 and 30 minutes. Also, the interviews held with the founding director of MSP set a research relationship similar to the interactive research approach described by Ellstrom et al. (2011), generating a bidirectional flow of information and knowledge between practice and research.

The third study reviews the literature regarding the formal and informal links between Science Parks and the local university to attract talent. The collection of readings consisted of a list taken from references of selected articles and the results of searches in the Google Scholar, Scopus, and Web of Science databases for a set of keywords. An interactive refinement process was carried out, rejecting some papers after analysing the abstract and including new ones taken from citations. The interactive process continued until the new references found were either already in our set of articles or did not contribute to the study.

The interactions collected in the literature review were characterised by two dimensions related to the degree of formalism and alignment with a strategic objective, according to the maturity level of the tenant firm involved in the interaction.

In addition, six descriptive cases were developed to illustrate the results of the study since the relationship between Linköping University (LiU) and MSP focuses not only on the commercialisation of university knowledge but also on attracting academic talent (Cadorin, Johansson, et al., 2017). Other factors that were accounted for include MSP's close relationship with LiU for more than 30 years (Etzkowitz & Klofsten, 2005) and that LiU and MSP share geographic, social, and cognitive forms of proximity (Boschma, 2005). For the cases, semi-structured interviews, lasting between 30 min and 60 min each, were conducted with one advisor from LiU Innovation Office, one senior advisor from Demola, and two representatives from Mjärdevi Science Park (the former and founder CEO and the current manager of Community and Employer Branding, with whom a follow-up interview was also conducted to obtain information about a new park activity and to test our theoretical model). In the end, each respondent validated the information written in the cases.

3.3.2. Quantitative approach

Studies 4 and 5 applied a quantitative methodology to validate the information identified in the literature and to test the results from the case studies. The statements and hypotheses drawn in these papers originated from the findings of the qualitative phase (Papers 1 to 3).

The preparation of these studies (Papers 4 and 5) included developing a questionnaire in two stages. First, the model was built and refined to generate questions that can be quantified. Exploratory procedures become more precise when the factors are measured using several variables in the analysis; the ideal amount of variables was between three and five for each element measured (MacCallum, 1990; Safón, 2009). Thus, most of the questionnaire items were measured according to Likert-type scales (1–5). Second, considering that the expected level of the respondents is equivalent to a director, president, or Science Park manager, the current and the former CEO of Linköping Science Park were asked to pre-test the questionnaire to identify ambiguities and avoid misinterpretations in the final version.

To ensure a relevant population of Science Parks in the survey and to obtain a better response rate, the International Association of Science Parks and Areas of Innovation (IASP) was invited to help conduct the survey. In December 2017, the first meeting with the IASP director general and operations director was held. The IASP team of professionals checked and reviewed the questions before being integrated into the IASP annual questionnaire "2018 IASP General Survey on Science and Technology Parks and Areas of Innovation". An entire section on talent-related issues was created in the IASP survey to incorporate the questions of this research project.

In June 2018, the questionnaire was then submitted to IASP full-member Science Parks in Brazil and Europe and was open for responses until September 2018. IASP oversaw contacting the Science Park managers and reminding them to respond to the survey. In the end, the result was a sample with responses from 59 Science Parks (a response rate of 50.4%): five in Brazil, one in Austria, one in Bulgaria, two in Denmark, two in Estonia, one in Finland, six in France, two in Germany, two in Greece, four in Italy, one in Latvia, one in Lithuania, two in Poland, three in Portugal, one in Serbia, one in Slovenia, six in Spain, five in Sweden, one in Switzerland, two in the Netherlands, six in Turkey, and four in the United Kingdom. In addition to the Science Parks that did not respond (58), three responses were not valid and were discarded because two were just incubators and one was just a "general contact".

The data collected with the questionnaire were analysed using a variety of analytical methods within Statistical Package for the Social Science (SPSS)[3] to verify variables' acceptability and validity. Correlation analysis performed at the variable level and the factor level identifies statistically significant measures, and regression analysis identifies the connections between dependent and independent factors.

Papers 4 and 5 explain the methodology and statistical analysis in more detail. The fourth paper strives to define the collaborations that occur regarding talent attraction processes and examined 22 variables, including eleven independent variables, five control variables, and six variables of Science Park performance – i.e., success dimensions. The fifth paper examines 25 variables, including four control variables, and aims to increase knowledge about managing talent attraction in Science Parks, having a particular focus on students and alumni of the university as human and strategic resources.

3.4. The papers of this thesis

3.4.1. Paper 1: Future developments for Science Parks: Attracting and developing talent.

a) Summary

Paper 1 is a qualitative study of how Science Parks can attract talent by considering stakeholders, relationships, and motivations of Science Parks. The central hypothesis of this study is that the performance of Science Parks is linked to their capacity to attract talent.

[3] https://www.ibm.com/analytics/spss-statistics-software

b) Division of work

Paper 1 was co-written with Professor Magnus Klofsten, a full professor at Linköping University, Sweden, and my supervisor in this research project, and with Mr Sten Gunnar Johansson, a former CEO of MSP. Magnus Klofsten and I collected data from MSP and from the LEAD incubator. Sten Gunnar Johansson described the development of MSP from its founding in 1984 until recently, providing us with historical information that helped identify different talent-related cases during MSP's development.

I wrote the introduction section, which also incorporates a literature review. Magnus Klofsten offered valuable comments to guide me in the construction of the methodology section and contributed to developing the analysis and conclusion sections. Sten Gunnar Johansson also contributed by proposing many practical implications. I led the review process with the journal editors, making the requested adjustments or justifying the refusal of the proposed changes. All authors reviewed and approved the paper's final version, which was peer-reviewed by anonymous reviewers as part of the publication process in the *Industry and Higher Education Journal* in 2017.

3.4.2. Paper 2: Science Parks and the attraction of talents: activities and challenges.

a) Summary

Paper 2 is a qualitative study that explores the activities carried out by Science Parks to attract talent to their tenant firms. This study collects data from seven case studies on talent-attracting activities carried out by three Science Parks in Sweden. This study shows that the Science Parks implement many different talent attraction activities, whether looking for key personnel for start-ups or organising platforms that facilitate the establishment of firms in the park or even approaching academic talents as a way of making the Science Park more attractive to young talents.

b) Division of work

Paper 2 was co-written with Mr Magnus Klofsten, Mr Alberto Albahari from Universidad de Málaga, Spain, and Mr Henry Etzkowitz from Stanford University, USA. Magnus Klofsten and I collected the main data by interviewing the CEOs of the Science Parks. Under the supervision and collaboration of Magnus Klofsten, I led the writing of the Introduction, Literature Review, Method and Data, and Policy Implication sections. Magnus Klofsten guided me in the data analysis process and supported me in constructing the conclusions. Alberto Albahari made valuable contributions to the Introduction, Literature Review, and Policy Implications sections. Henry Etzkowitz provided helpful knowledge about the development of Science Parks in the world and the Triple Helix model, which was valuable for constructing a historical context for the Introduction and Literature Review sections. He also contributed to the Conclusion and Implications sections. I led the review process with the editors, making the requested adjustments or justifying the refusal of the proposed changes. All authors reviewed and approved the paper's final version, which was peer-reviewed by anonymous reviewers as part of the publication process in the *Triple Helix Journal* in 2020.

3.4.3. Paper 3: Universities and Science Parks: Engagements and interactions in developing and attracting talent.

a) Summary

Paper 3 is a qualitative study that reviews the literature on the interactions between Science Parks and universities. Talent attraction and entrepreneurship are discussed as the main structures of these interactions. This study gives more insights into concrete activities that

Science Parks and universities develop to deliver skilled human resources for the park and the region. This study identified different types of interactions according to the maturity levels of firms. When firms are in the start-up stage, they focus more on their growth, and as they mature, they shift focus to their development.

b) Division of work

Paper 3 was co-written with Ms Eloïse Germain-Alamartine, PhD student at Linköping University, Ms Dzamila Bienkowska, Assistant Professor at Linköping University, and Mr Magnus Klofsten. I collected and analysed the literature on talents, Science Parks, and their collaboration with universities, writing the Literature Review and Method sections related to these subjects. Eloïse made identical sections in relation to the entrepreneurial university. Then, Eloïse and I conducted the interviews with personnel responsible for the illustrative cases, and I was responsible for composing the Illustrative Cases of Interactions section. Also, along with Eloïse, we created the first version of the model, which received valuable improvements from Magnus and Dzamila until it reached the final version. Eloïse and I led the review process with the editors, making the requested adjustments or justifying the refusal of the proposed changes.

Working in collaboration with another PhD student and professors with experience in entrepreneurial universities enabled me to deepen my theoretical knowledge about the role of the university in the formation of entrepreneurs as well as the various interactions between the university and the management of the Science Park aimed at the development of academic talents.

All authors reviewed and approved the paper's final version, which was peer-reviewed by guest editors and published in the Springer book *Developing Engaged and Entrepreneurial Universities* in 2019.

3.4.4. Paper 4: Science Parks, talent attraction and stakeholder involvement: an international study.

a) Summary

Paper 4 is a quantitative study of how talent characteristics and the collaborations between Science Parks and their stakeholders promote talent attraction, which may include attracting professionals with specific expertise or facilitating the establishment of foreign firms in the Science Park.

b) Division of work

Paper 4 was co-written with Professor Magnus Klofsten and Professor Hans Löfsten, full professor at Chalmers University of Technology and my assistant supervisor in this research project. With the valuable comments and suggestions from the other two authors, I developed the model tested in Papers 4 and 5. I was also responsible for the Literature Review section, and Magnus wrote the Introduction section. Professor Löfsten led the quantitative analysis and composed the corresponding part of the paper. We all worked on the Discussion, Conclusion, and Policy Implications sections. I led the review process with the editors, making the requested adjustments or justifying the refusal of the proposed changes. All authors reviewed and approved the paper's final version, which was peer-reviewed by anonymous reviewers as part of the publication process in *The Journal of Technology Transfer* in 2021.

3.4.5. Paper 5: Science Parks and talent attraction management: university students as a strategic resource for innovation and entrepreneurship.

a) Summary

Paper 5 is a quantitative study that tests another part of the research model. The purpose was to deepen knowledge about the activities aimed at attracting talent developed by the Science Parks, focusing on the relationship with the university and its students and alumni, all strategic resources. The study investigates how the management of the Science Parks can promote successful relationships with universities and academic talents that support the development of the tenant firms and the Science Park itself.

b) Division of work

Paper 5 was co-written with Professor Hans Löfsten (the first author) and Professor Magnus Klofsten. For the first time in this research project, I was not the first author of a paper, mainly because I had to return to Brazil and started working in parallel with the PhD course. As a third author, I made contributions to the Literature Review section, mainly concerning Science Parks, talent, and talent management theories. Magnus was responsible for the Introduction section. Professor Löfsten led the written process and conducted a quantitative analysis of the survey data. We worked together in the Discussion and Implications and Conclusions sections. Professor Löfsten also led the review process with the editors, making the requested adjustments or justifying the refusal of the proposed changes. All authors reviewed and approved the paper's final version, which was reviewed by anonymous reviewers as part of the publication process in the *European Planning Studies* journal in 2020.

3.5. Validity and reliability

The quality of a study can be determined by its validity and reliability. Validity can be described as the best possible estimate of the truth of a given statement or inference (Donald Thomas Campbell & Cook, 1979). The reliability of a study is related to the stability and consistency of its results (Carmines & Zeller, 1979), and it is guaranteed if, under identical conditions, the repetition of the study procedures provides the same result. Therefore, reliability is essentially a reduction of bias and errors to the minimum level (Moser & Kalton, 1989; Yin, 2003).

3.5.1. Qualitative studies

Validity in qualitative studies involves ensuring the accuracy of the definitions presented, the measurements made, and the procedures applied (J. W. Creswell & Clark, 2007). Preference was given to definitions taken from highly cited studies and renowned authors in the fields or those used by internationally recognised associations.

In the data collection for the qualitative studies, the primary resource used was interviews, which involves several subjective factors that can influence the accuracy of the information collected. To minimise such problems and increase the validity of the answers, interactive processes were adopted. For example, the interviewees were given the opportunity to comment on their responses and how the responses were categorised. That is, the interviewees were encouraged to review, comment, and revise the interview material. An undesired effect of this interactive process is that it takes a great deal of time and effort; however, this approach helps mitigate researcher bias.

Furthermore, the interviews were carried out preferably by telephone or computer video calls, guided by a previously defined structure used in all meetings. In this way, the interviews followed a semi-structured pattern that allowed collecting the same type of information with all the interviewees but giving them the freedom to add new information and suggest other people to be interviewed, a process that resembles the snowball effect mentioned by Yin (2003).

Finally, the case studies were also validated by people with extensive knowledge of the subject addressed but were not involved in the data collection phase. Thus, these validators could independently verify, comment, correct, and validate the results. In addition, the activities that proved unsuccessful or were ended by the Science Park for any reason are also present in the studies and therefore make this research more reliable and connected with reality (J. Creswell, 2009).

3.5.2. Quantitative studies

In quantitative studies, it is necessary to validate the construction and statistical analysis. Although questionnaires tend to be highly reliable and aim to guarantee data integrity, they also introduce measurement errors since the number of analytical variables that can be used is limited (Bonoma, 1985).

In the quantitative studies of this research, responses from 59 Science Parks were used, which can be considered a significant number when compared to other quantitative studies carried out on Science Parks (Albahari et al., 2018; Gwebu et al., 2018; e.g. Link & Scott, 2006; Listyaningrum & Van Geenhuizen, 2019). However, the selection was not entirely random since the survey was submitted only to IASP full-member Science Parks in Brazil and Europe. Since the decision was made to work in cooperation with the IASP, a pre-selection was made, so bias was introduced and needed to be considered in the analyses. Then, the external validity of the results is restricted to a generalisation only to IASP full-member Science Parks in Brazil and Europe. Regarding internal validity, the selection bias mainly addresses the differences and similarities found in the sample. However, it is worth noting that the support from IASP resulted in an adequate number of responses to perform the statistical analysis and optimised the entire process of sending the questionnaire and following up on the responses.

3.6. Limitations

In any research, it is natural to have limited resources, and unexpected situations can happen during the investigation that affect the depth with which the subjects are approached or even neglecting to consider some aspect of the phenomenon. Also, the background of the researcher can influence the research design. That said, during the development of this thesis, we identified our assumptions and limitations as transparently as possible and noted possible corrections for consideration in future studies.

In addition, few studies address the development of Science Parks from the perspective of talent management and the collaborations with stakeholders in talent attraction processes (e.g. Guerrero & Berbegal-Mirabent, 2016; Koh et al., 2005). Therefore, the research framework was built on a theoretical basis formed by several areas of information such as Science Parks, human resource management, talent, and talent management. Considering that this subject is little explored in the academic literature, other valuable areas may have been overlooked.

Although it is possible to find studies defining talent, there is no consensus in the literature regarding its definition, but the meaning presented in the context of human resources is often considered the most correct (Gallardo-Gallardo et al., 2013; Mcdonnell et al., 2017). The challenge of formulating a precise definition is probably due to the fact that talent is a subjective concept with several interpretations, so its meaning is adjusted according to the context in which the phenomenon is being studied (Florida, 2002; Tansley, 2011). For this research project, we have simplified the concept of talent to individuals who have skills, knowledge, creativity, professional competence, communication, and leadership ability (Saddozai et al., 2017) as well as have the capability or potential to contribute to the growth of the tenant firm they are linked (Mcdonnell et al., 2017; Thunnissen et al., 2013).

Science Park literature points out that it is extremely complicated to measure the performance of Science Parks or even to qualify their level of success because of their heterogeneity (Albahari et al., 2017, 2018; Poonjan & Tanner, 2019). Each Science Park has its own characteristics and its objectives and therefore different motivations that result in different actions, decisions, and stakeholders. The challenge, then, is to form criteria capable of measuring all Science Parks on the same comparative scale (Albahari et al., 2017, 2018; Liberati et al., 2016). Finally, quantitative data were collected in a single moment, making it impossible to capture the evolving nature of stakeholders, activities associated with attracting talent and the performance of the Science Park.

4. DISCUSSION

This chapter discusses the empirical findings of the five papers (1-5) on which the present thesis is based. Each of the following sections addresses one research question at the empirical level. In the final section, this chapter links the main empirical findings to the research questions.

4.1. How Science Parks organise talent attraction activities

The first research question asked how Science Parks organise talent attraction activities, whether alone or in collaboration with other actors. The papers in this thesis describe various activities that Science Parks perform to attract talent, such as creating platforms for recruiting international firms and professionals, attracting key personnel for start-ups, and setting up or including student collectives in new or existing business networks.

Since the inception of Science Parks, talent has been essential to their success (Paper 1). In the early developmental stages of Mjärdevi Science Park (MSP), for example, the park experienced a lack of talent and had a shortage of professionals with needed qualifications in its management team. This situation weakened the support for tenant firms and the efforts to establish soft factors such as a prestigious address (Ramírez-Alesón & Fernández-Olmos, 2018; Storey & Westhead, 1994) and branding (Cadorin, Johansson, et al., 2017; Lam et al., 2021; Salvador, 2011). Observation yielded the perception that stakeholder involvement in the talent attraction activities developed by MSP management was in constant evolution, and tenant needs concerning talent were revised as the number of firms recruited to MSP increased.

In order to strengthen diversity among MSP tenants, MSP (Paper 1) made efforts to consolidate the image of MSP in the international arena and organised networking activities to attract international firms

(Papers 1 and 2). Such firms potentially bring teams of skilled workers representing a variety of qualifications and backgrounds into MSP. Such a mix of capabilities and cultures boosted the range of talents that MSP needed for networking, boundary spanning, and transfers of experiences to meet future challenges (see the discussion of "critical mass'' in "Klofsten et al., 2015). Moreover, to support the entrance of these international firms, MSP offered supportive activities (Paper 2). Assistance was primarily given for business matters but also included help with immigration matters, housing, and contacts with government authorities.

The needs among new firms for talent is something that also affects how Science Parks organise their talent attraction activities (Papers 1 to 3). Most new firms in the Science Parks are spin-offs of tenant firms or transfers from the local university. The transfers coming from the university have had the support of academic entrepreneurship courses that helped students and researchers develop their business ideas and prepare them with the necessary abilities and knowledge for evolving the business and entering the incubator. Spin-offs from existing firms naturally have support from the parent firm. However, incubator start-ups who have had no previous assistance from a university or parent firm tend to have poorly defined processes (Rompho, 2018) and depend more on Science Park and incubator support (Zhu & Tann, 2005) for assistance in attracting, among others, a CEO, board representatives, or IT personnel (Bøllingtoft & Ulhøi, 2005; De Cleyn et al., 2015).

Thus, the incubators are directly involved in supporting start-ups to attract talent (Papers 1 and 2). It seems that the proximity of incubator management to the start-up team makes them best suited for designing activities that fill knowledge gaps among them. Branding and the Science Park environment may also contribute positively to supporting start-ups in building their network of contacts and attracting the proper professionals (Papers 1 and 2).

Cases (Papers 1 and 2) have suggested that, besides bringing firms into the Science Park, another way to attract talent is to reach them directly. To this end, the Science Parks (Paper 2) develop talent attraction activities according to the type of talent desired and the maturity level of the tenant firms. Then, the Swedish Science Parks, in the cases studies (Papers 1 and 2), carried out other networking activities designed to attract qualified workers from regional, national, and international markets. For instance, a physical arena developed by one Science Park received an increasing number of visitors over the years enabling tenants to expand their networks and find new business opportunities.

Among the integration activities that MSP organised, the mediation of connections between tenants firms and nearby universities aiming to establish research links and facilitate the hiring of graduates stands out (Poonjan & Tanner, 2019; Vedovello, 1997).

Science Park management tended to consider university students as potential talents (Florida, 1999; Thunnissen & Van Arensbergen, 2015) and, although the geographic proximity of the Swedish Science Parks (Papers 2 and 3) with their connected universities has not always facilitated the recruitment of students, the parks developed integration initiatives for approaching student associations and connecting with university talents aiming to spread information on Science Park initiatives.

Evidence that Science Park managers are aware that encouraging closer ties between tenant firms and university students is a beneficial way of attracting potential talent comes from the survey data of 59 Science Parks (Papers 4 and 5). This initiative seems to enable students to expand their network of contacts and develop their professional skills while tenant firms have the opportunity to test students in real business situations. For example, in one case (Paper 3), Science Park management teamed up with university student organisations to host annual recruitment fairs, thus creating an ideal meeting ground for university students and firms of all maturity levels. The result of this approach appears to be a greater likelihood of employment upon graduation (Hommen et al., 2006).

Moreover, the findings (Papers 4 and 5) showed that the government actor seems to have a key role in promoting collaboration between firms and universities and improving innovation and technology transfer processes. Also, the government and local authorities appear to demand some requirements concerning the orientation of the Science Parks, and relationships with these authorities may allow the Science Parks to offer their tenant firms efficient policy assistance and generate a stable environment for the attraction of talents.

An initiative of a Science Park (Papers 1 and 2) to get closer to the student community was forming a student board formed by students from various academic fields. This board worked in parallel with the Science Park board, generating new perceptions and objectives for developing the Science Park and its firms. It was also noticed that incorporating younger mindsets into decisions made by the Science Park created a bidirectional flow of information. The student board members became Science Park ambassadors, spreading information on opportunities and advantages of working with the Science Park to their fellow students. In return, students' aspirations, mentalities, and innovative ideas became accessible to Science Park management.

The idea of examining university talent was expanded to include the alumni network (Paper 3). One project invited former students who had left the region after graduation to return to the Science Park. The objective was that the alumni could interact with the employees at tenant firms to propose improvements in the processes and products of the firms. The Science Park was acting on an awareness that former students often had qualifications and professional experience which could benefit the firms (Huffman & Quigley, 2002).

4.2. How does collaboration with stakeholders influence Science Parks planning for talent attraction activities and their performance?

The second research question explored how collaboration with stakeholders influences Science Parks planning for talent attraction activities and their performance. To this end, the present thesis analysed how Science Parks collaborate with various actors, mainly in university sectors and the government, and how these relationships can affect the performance of Science Parks. This thesis also discusses how stakeholder roles and talent characteristics affect the planning of talent attraction activities and influence the success of the Science Park.

Collaboration with various actors, mainly with government agencies and the local university, is crucial during the Science Park development (Paper 1). The government supported MSP in expanding its brand internationally and advertising information about its services, facilities, and opportunities. In addition, the incubator at MSP worked actively to attract leaders, managers, and other professionals to supplement start-up teams. The incubators' process to attract talent to start-ups was described as being carried out in common agreement with the start-ups and based on their real needs, with special attention when the objective is to attract a new leader to the team.

Science Park management appears to promote interactions between tenant firms and the local university in order to stimulate technology transfer, create joint projects, and facilitate the attraction of academic talent (Paper 2). In particular, park management encourages the involvement of tenant firms in activities and courses promoted by the local university because they are an exceptional opportunity for tenant firms to get closer to university students and develop a relationship that involves little investment of money and time (Hjelm & Lindahl, 2016). For example, one university course created projects based on the real problems of tenant firms where groups of university students worked with tenant firm employees to propose solutions (Paper 3). Such collaborations between tenant firms and the university appear to generate bonds that will contribute to the attraction of these students after their graduation (Huffman & Quigley, 2002).

Student associations were found to be an essential actor in the communication process between a Science Park and university students (Paper 3). In collaboration with these associations, Science Park management promoted job fairs on the university campus to increase interaction between students and tenant firms at the Science Park. These fairs seem to be one way for students and firms to get to know each other better and enhance the hiring of graduates. Graduates are a source of new and innovative ideas for firms which are a positive factor in firm development and, consequently, the overall performance of the Science Park.

Another case described how the Science Park interacted with government agencies and the local university to strengthen ties with the alumni network (Paper 3). The event resulting from the collaboration between the municipality, the university, and the Science Park allowed former students to network and learn about Science Park opportunities. The main objective of the event was to convince students to return to the region; the business experience they acquired elsewhere would potentially be beneficial, contributing to the value of both small and large firms on the Science Park.

Collaborations between Science Parks and stakeholders in the government and academia for developing activities to attract talent seem mainly designed to promote innovation and efficient technology transfer processes (Paper 4). The statistical analysis found these collaborations to be positively correlated with the success of the surveyed Science Parks (Paper 4). The characteristics of the talent attracted to the tenant firms were found to be positively correlated not with technology transfer processes between the local university and industry but with the success of the tenant firms and the Science Park (Papers 4 and 5).

4.3. Implications of the research findings on Science Park talent attraction activities for research and practice

The third research question discusses the implications of the research findings on Science Park talent attraction activities for research and practice. The present thesis proposes recommendations that can help practitioners (Science Park managers, government authorities, and others involved in its development) improve policies for attracting and maintaining a steady inflow of talent into the Science Park. Researchers in the fields of Science Parks, human resource management, and talent management may also find implications for their research paths.

Among the many ways, Science Parks can contribute to the talent management process of tenants, creating an attractive environment and actively working in the search and attraction of talents (Papers 1 to 3). The cases in the thesis papers suggest that Science Park managers are creating opportunities for firms to interact with academia to facilitate the flow of knowledge and talent. Such interactions promote the creation of new knowledge-intensive firms (Klofsten and Lundmark 2016) and may also contribute to the growth of existing firms in Science Parks (Klofsten and Jones-Evans 2013). Collaborating with government and university actors to facilitate access to the alumni network of universities and improve the available pool of talent seems to be an important activity for anyone involved in Science Park development (Papers 3 to 5).

The government plays a role in Science Park success by providing resources for R&D projects, encouraging the relationship between industry and academia, and supporting technology transfer processes (Paper 4). The government could also support Park firms by facilitating the establishment of firms in the Science Park (Paper 2). Another implication of the present thesis is that, in the role of Science Park allies, government agencies such as embassies could assist in publicising Science Parks on the international stage (Paper 1). Thus, the positive implications of government involvement with Science Parks include indirect talent attraction through incoming firms, promotion of the Science Park brands internationally, and innovation support. Government involvement could therefore contribute to a more attractive environment in the Science Park.

Furthermore, Science Park managers have indicated that they support established firms entering the Science Park (Papers 1 to 3) and consider incubators as partners in helping start-ups in their talent interests (Papers 1 and 2). The case studies (Papers 1 to 3) and the statistical analyses (Papers 4 and 5) in the present thesis identified how Science Park practitioners perceive activities for attracting talent as belonging to the portfolio of services that Science Parks offer to their tenant firms. The literature indicates that good talent management practices can improve the performance of firms (Mcdonnell et al., 2017). The present thesis suggests that if Science Parks can accomplish effective talent attraction activities, the performance of the tenant firms may improve. In fact, Science Park managers seem to consider these activities as one of the services that add value and contribute to the growth of their tenant firms.

4.4. Summary

This chapter discussed the activities developed by the Science Parks and their interactions with stakeholders. Table 6 summarises the empirical findings of the published papers in the present thesis (Papers 1 to 5) and how they are related to the three research questions.

This thesis (Papers 1 to 3) showed the various activities for attracting talent developed by the Science Parks in the papers and described such activities in-depth, exploring Science Park objectives, stakeholder involvement, and the challenges that Science Parks faced when organising each activity.

Table 6 – The three research questions and empirical findings.

Research questions (RQs)	**Main empirical findings**
RQ1: How do Science Parks organise talent attraction activities, either on their own or in collaboration with stakeholders?	Science Parks seem to organise networking, supportive and integration activities to attract talent, either on their own or in collaboration with stakeholders at the business and individual levels. Science Parks seem to organise talent attraction activities, on their own or in collaboration with stakeholders, according to the characteristics of talent desired and the tenant firms' maturity level.
RQ2: How does collaboration with stakeholders influence Science Parks planning for talent attraction activities and their performance?	Collaborations with government and academic stakeholders seem to promote innovation, strengthen Science Park branding, and facilitate academic talent attraction, contributing positively to the development of tenant firms and the performance of Science Parks. Collaborations with government and academic stakeholders appear to increase the numbers of tenant firms and, thus, the number of available jobs, contributing positively to the performance of Science Parks.

RQ3: What are the implications of the research findings on Science Park talent attraction activities for research and practice?	Talent attraction activities were found as one of the services offered by Science Parks and are a possible new area of research in the fields of Science Parks, human resources, and talent management. Science Park managers seemed to consider the maturity of the tenant firms, their needs for talent, and the characteristics of the desired talent as decisive factors in planning and developing talent attraction activities. Government agencies seem to have an essential role in supporting the links between the tenant firms and the university and in the international dissemination of the Science Park's brand.

Moreover, the data showed that stakeholder participation seems to be essential for attracting talent (Papers 4 and 5). The studied Science Parks primarily collaborate with government agencies and local universities, and these interactions seem to be fundamental to the success of talent attraction activities and positively influence the performance of Science Parks. The university connected to the parks studied in the papers plays an important role in supplying a specialised workforce of young talent who may become entrepreneurs for a generation of new ventures (Papers 2, 3 and 5). Also, links with stakeholders tend to increase the chances for the growth and success of tenant firms (Paper 4), and growing firms create a favourable environment for improving the quantity and quality of talent in the Science Park.

Finally, each of the papers in the present thesis recommends policy implications of talent attraction activities developed by Science Parks that can be addressed in research and practice. The papers also suggest studying talent attraction activities from the perspective of human resource management and the contributions of such activities to Science Park development. Moreover, practitioners work to create an attractive environment in a Science Park, strengthen the Science Park brand, and effectively communicate with university talents. Science Park managers seemed to consider the firm's maturity level and the characteristics of the desired talent when fulfilling the talent needs of firms. Also, government authorities appeared to contribute to Science Park talent attraction by supporting innovation initiatives and the establishment of incoming firms.

5. CONCLUSIONS AND FUTURE RESEARCH

This final chapter highlights the main conclusions of the present thesis and its contributions. The implications for the study of Science Parks and their practice are also discussed. This chapter concludes by identifying some limitations of the present work and outlining proposals for future research.

5.1. Main conclusions

The present thesis explores how Science Parks conduct activities to attract talent for themselves and their tenant firms. The discussion (chapter 4) reported how Science Parks connected young and growing firms with key personnel and management professionals from collaborating with stakeholders; supported the long-term development of new businesses through management-developed initiatives; promoted an innovative environment alone, and often in collaboration; were involved in the stakeholder-supported transfer of knowledge and talent between tenant firms and the local university.

5.1.1. Research question 1

Science Parks and talent management

Talent attraction activities organized by Science Parks vary depending on the maturity level of the tenant firms (Storey & Tether, 1998). On the one hand, firms with goals primarily with regards to growth and consolidation require more experienced management to address the shortcomings of the team. Young entrepreneur-founded firms with roots in the local university and tenant firms are sources of innovation in a Science Park. However, one of their weaknesses is an initial lack of professionals in key positions (Bøllingtoft & Ulhøi, 2005; De Cleyn et al., 2015; Zhu & Tann, 2005). One task of Science Park management, with the park incubator acting as the support agent, is to assist such firms in strategic headhunting personnel via the park's extensive network of contacts, including stakeholder contacts. The recruitment process must be conducted with great sensitivity as it is focused on a specific, concrete need of the start-up and should agree with the start-up team, especially when the search is for a new leader.

On the other hand, more mature firms have consolidated processes and do not rely on external support. However, they need innovation to remain competitive and thus are more in need of talents with fresh and innovative ideas (Klofsten & Jones-Evans, 1996; Kusmana, 2019). These differences in needs also define whether talent activities are carried out in collaboration with stakeholders or solely within the framework of the Science Park.

Science Parks and context

Science Parks need to leave their footprint in the international arena to be of interest for needed talent. Of the many ways to improve the international image of a Science Park and attract talents, establishing a prestigious address (Ramírez-Alesón & Fernández-Olmos, 2018; Storey & Westhead, 1994) and creating image effects (Ferguson & Olofsson, 2004; Gwebu et al., 2018) to gain recognition through social signalling (Felsenstein, 1994; Gwebu et al., 2018) and socio-cognitive effects (Wennberg & Lindqvist, 2010) cannot be underestimated. These elements contribute to a global, positive image of the Science Park and help build an innovative environment suitable for business development, indispensable to any plan drawn up by Science Park managers for attracting talent.

Also, successfully attracting and retaining international firms and talent means, among other things, that Science Park support services minimise barriers to entry and assist in a smooth settlement in the Science Park. The purpose of the support is to help foreigners integrate into the receiving country system by assisting in areas such as housing, healthcare, schools, and taxation, and contacts with other government channels. These integration activities positively impact the Science Park brand, long-term relationships, and collaborations between international talent and the Science Park.

5.1.2. Research question 2

Science Park – stakeholder interactions

Two primary stakeholders in Science Parks are governments and universities, and the collaborations with them facilitate R&D funding (Albahari et al., 2011; Link & Scott, 2003), supply tenant firms with talent and technology (e.g., patents) from universities, strengthen Park branding and stimulate the innovation and entrepreneurial culture in the Science Park (Hansson et al., 2005). Without such a platform and stakeholder collaborations, talent attraction activities would be less easily developed. Thus, links with government representatives and with the local university, including student body committees, provide tenant firms with vital resources such as funding, know-how, technology, and young, talented workers.

Science Park performance

The literature proposes a set of indicators for measuring Science Park performance such as innovation results, tenant success, firm-academic and firm-firm relationships, and the presence of individuals with the talent and motivation to produce and commercialise knowledge (National Research Council, 2009; Rowe, 2014). In fact, the number of successful tenant firms and the number of workers influence Science Park's performance (Guadix et al., 2016; Rowe, 2014).

Therefore, park management needs to organize activities to attract talent with the fitting characteristics for each tenant because firms that are able to fill their expertise gaps with the right skilled professionals have a greater chance of improving their organizational performance (Lu et al., 2015) and, consequently, the performance of the parks.

Finally, the present thesis proved that the model proposed in Chapter 2 was valid. In other words, the talent attraction activities developed by the researched or observed Science Parks mediate the influence of the talent characteristics and the park's characteristics, structure, processes, and stakeholders on the Science Parks' performance.

5.1.3. Research question 3

Implications for practice in the broader context

This section discusses some practical implications that may guide practitioners – such as Science Park management teams, government authorities, and others involved in growing Science Parks – toward strategies that would stimulate Science Park development and success.

Talent attraction is closely linked with the degree of inspiring and challenging work that Science Park can offer. Highly inspiring and challenging work is possible when Science Park tenancy reaches critical mass (see Klofsten et al., 2015). Thus, park management should view the formation of a pool of talent as a top priority as it would serve to maintain the minimum number of professionals needed to supplement the characteristics and experiences of the talent that is already available at the Science Park. Tenant firms are then strongly motivated to innovate and develop new successful businesses. Talent attraction should consider the maturity level of the tenant firms and the characteristics of the desired talent.

To create an attractive environment for talents, Science Park branding (i.e. the strength of its name, image, and the ideas associated with it (Ferguson & Olofsson, 2004; Gwebu et al., 2018)) is fundamental. Thus, managers should spread information about the Science Park and upcoming opportunities by organising events at the Science Park, participating in international conferences, and using online channels such as social media.

Science Park managers can also support tenant firms by searching business networks at the Science Park for needed skilled professionals or assisting international talent and firms with obstacles unfamiliar to newcomers from abroad. The aim to reach academic talents at local universities, in student communities, and through alumni networks could be accomplished, for example, by creating an arena to bring students and Science Park decision-makers closer together or by mediating links between tenant firms and the local university to encourage technology and talent transfer.

Moreover, Science Park stakeholders play a crucial role in promoting innovation, encouraging an entrepreneurial culture and building an attractive environment for talent (Hansson et al., 2005). Therefore, strengthening engagement with stakeholders, such as the government and universities, promotes innovation in the Science Park and develops efficient technology transfer processes, driving Science Park development and justifying a public investment in Science Parks (Albahari et al., 2013).

The university linked with the Science Park is essential for supplying it with young talents that tenant firms can employ or who are able to start new ventures (Poonjan & Tanner, 2019). Thus, Science Park managers need to work with universities to encourage courses and seminars in entrepreneurship that give tenant firms access to university talent and cutting-edge academic developments in their field.

Government actors should provide access to public services, including but not limited to transportation, security, education, and health systems (Etzkowitz & Zhou, 2018). In return, the government can be expected to demand the development of new, innovative products that stimulate regional growth. To deliver on these expectations, Science Park managers will need to seek support from (i) public funding agencies for the development of R&D and (ii) national embassies abroad for the international dissemination of information on tenant firms and the Park brand (Laamanen & Autio, 1996; Marinazzo, 1996).

In summary, everyone involved in the management and development of Science Parks needs to actively work to strengthen the park brand and participate in the international scene. These strategies will contribute to creating an attractive environment and effectively communicate with university talents. In order to be able to maintain a critical mass of talent in the Science Park, managers should develop talent attraction activities according to firm maturity and the characteristics of the desired talent (Klofsten et al., 2015).

Implications for practice within the context of my future work

As discussed in Chapter 3, this project is part of a bilateral agreement between Brazil and Sweden that aims to deepen knowledge on the development of Science Parks. The primary beneficiary in Brazil of this study is the Army, which offered me enough support during my advanced studies.

It is worth saying that the knowledge acquired in this research project is already being put to use in Brazil, e.g., in 2017, the Brazilian Army journal "Revista Militar de Ciência e Tecnologia" published an academic paper (Cadorin, Klofsten, et al., 2017) resulting from this research project. The paper describes the development of Mjärdevi Science Park (now Linköping Science Park), in Linköping, Sweden, from its first years until its consolidation on the world stage. The in-depth description of Science Parks development can serve as a model for similar initiatives that the Brazilian Army may undertake.

After three years of immersion studies at the University of Linköping, I returned to Brazil in 2018 to begin implementing the knowledge I had acquired in Sweden. Since then, the Brazilian Army Technological Innovation and Management Agency (AGITEC; Agência de Gestão e

Inovação Tecnológica) and the Brazilian Army Military Institute of Engineering (IME; Instituto Militar de Engenharia) have increasingly made direct use of the knowledge I gained.

AGITEC is a military agency created in 2018 for conducting and coordinating the Army's innovation processes, which occur mainly at IME and the military research centres. The directive of AGITEC is to promote and guide innovation at Army organisations, coordinating the main national actors that constitute the triple helix and their projects for developing defence products. The knowledge I gained from my studies in Sweden has significantly contributed to improving human resource management in the Army and developing talent attraction processes for recruiting qualified professionals to military projects. The challenges include creating the necessary conditions to attract the appropriate talent to defence projects and reconcile differing interests between the business and military environments.

IME is the oldest engineering school in Brazil, founded in 1792 and maintained by the Brazilian Army. The Ministry of Education of Brazil recognizes the Institute as one of the best engineering schools in Brazil, and as I have a degree in engineering and completed my master's degree at this school, I am proud to say that IME is my alma mater. The application of knowledge acquired in Science Parks development, talent, innovation, and entrepreneurship over almost five years of studies involves participating as an instructor in courses and as a speaker at events at IME.

The main contribution of the present research project is to ensure that the innovative culture change in the Army environment is lasting and that current and future generations of military commanders recognise the need to create an innovative environment in R&D facilities, attract talent, and encourage firms of all sizes and maturity to work on the development of defence products.

5.2. Main contributions

Chapter 1 identified two areas of knowledge gaps, namely the mechanisms through which Science Parks support tenant firms and the perspective often adopted in studies on Science Parks. This thesis contributes to clarifying these gaps.

According to Davis and Parker (1997), the contributions of a thesis to its field can include one or more of the following categories: new or improved evidence, new or improved methodology, new or improved analysis, and new or improved theory. By shedding light on how talent attraction activities influence Science Park development, the present thesis thus contributes to research on the development of Science Parks with:

1. New or improved evidence: talent attraction was introduced as a conceptual element.
2. New or improved analysis: a model was developed to include the influence of the new element, talent attraction: (i) in a supply-side perspective and (ii) as a mediator of Science Park performance.

Chapter 2 of the present thesis pointed out that Science Parks and talent management are seldom discussed together in the literature. Thus, this thesis contributes to research on Science Parks by bringing these two research areas together and evidencing talent attraction as a new conceptual element (see Bellavista & Sanz, 2009, p. 502) essential for explaining the influence of human resources on Science Park development.

Previous studies (see Lindelöf & Löfsten, 2003; Monck et al., 1998; Ramírez-Alesón & Fernández-Olmos, 2018; Westhead, 1997) have often addressed the more traditional Science Park services offered to tenant firms, and the analyses are based on comparing the benefits to whether or not the firm is a Science Park tenant. Instead of viewing this question from the perspective of tenant firms - the demand side and the usual strategy - the present thesis approached the issue from the perspective of Science Park management (the supply side) (Albahari et al., 2011). This approach supplements previous studies by illustrating how Science Parks perceive the benefits of attracting talent to tenant firms. Surveys of managers about their attitudes toward and motivations for supporting the growth and success of their tenant firms made supply-side perceptions possible.

The model proposed in the present thesis (see Chapter 2) expands our knowledge of the mechanisms that Science Park managers use to improve performance and create value for tenant firms. The model shows that the characteristics of talents; the structure, processes, and characteristics of Science Parks; and relationships with stakeholders positively affect the development of activities for attracting talent. The model supplements existing research on Science Park development (Albahari et al., 2013, 2019; Bigliardi et al., 2006; Weng et al., 2019) by introducing talent attraction activities as mediators for Science Park performance. The model thus offers tools for analysing Science Park performance based on an understanding of how they carry out talent attraction activities. Knowing the features of a Science Park (i.e., the characteristics, structures, and processes) and its relationships with stakeholders, efficient activities for attracting talent can be designed and executed, and Science Park performance will improve. The involvement of government and university actors in talent attraction activities developed by the Science Parks can contribute to their success by promoting efficient technology transfer and innovation generation processes (Poonjan & Tanner, 2019). Talent characteristics should receive special attention in the planning and execution of attraction activities to reach those who meet the needs of the tenant firms (Löfsten et al., 2020).

Finally, this thesis presents improved evidence and new and improved analysis which contributes substantially to the Science Park literature, identifying and empirically examining critical factors of Science Park performance.

5.3. Limitations of the thesis

The limitations of the present thesis also offer promising avenues for future research, primarily in the fields concerning Science Parks and their mechanisms for attracting talent to tenant firms. This section presents two limitations that have already been identified and proposes paths for future work.

The first limitation is qualitative in that the present thesis is based on seven cases in three Swedish Science Parks. Collecting information on Science Parks in the same country made it possible to keep some soft factors – such as economic, social, and cultural – constant and thus better identify talent attraction cases. However, the present thesis does not claim to have observed all types of talent attraction activities; other varieties of Science Park talent attraction activities than the ones discussed here most likely occur. Future studies should aim to capture other perspectives in new talent attraction cases than what the present research has found. Other types of talent attraction activities may also be identified. More cases and from other countries would enhance what is known about the characteristics, structures, and processes of Science Parks and their stakeholders; our understanding of the motivations and activities that Science Parks develop to attract talent would also increase.

A second limitation is quantitative and concerns data collection, which was based on a short period and included 59 European and Brazilian Science Parks. The present thesis was thus unable to capture the evolutionary nature of the stakeholders, the attraction of talents, and the development of Science Parks. Future studies can investigate other aspects of talent attraction activities and examine their progression over time. Longitudinal quantitative studies are desirable because they provide a better understanding of the interaction between dependent and independent terms over time and a better observation of possible changes in the behaviour of the respondent and the processes.

5.4. Future research

This thesis on the development of Science Parks addresses concepts belonging to different research areas, such as talent, talent management, and strategic management. In addition, talent management adopts insights and practices from various fields, such as human resource management, resource-based theory and capabilities (Sparrow et al., 2014). Thus, researchers can supplement the results of the present thesis with new studies that deepen the intersections between outside research fields and the development of Science Parks and talent management.

Moreover, future studies could explore the motivations and methods that Science Parks use to collaborate with their stakeholders on talent issues. For example, the university linked with the Science Park is a special stakeholder, and new studies could analyse how to support Science Parks and their links with universities better. In addition, new studies can have a qualitative or a quantitative approach and explore the extent to which the university influences the choices that tenant firms make and guides their activities to contribute to academic research or teaching.

Finally, it is highly recommended that future studies result in practical implications, improving the performance of the Science Park and all those involved in its development, and in implications for academia, enriching the literature on both Science Parks and talent management.

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PART II: PAPERS

1

Paper 1: Cadorin, E., Johansson, S. G., & Klofsten, M. (2017). Future developments for Science Parks: Attracting and developing talent. Industry and Higher Education, 31(3), 156–167.

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Future developments for science parks: Attracting and developing talent

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Abstract
Over the years, science parks have developed and improved their processes to offer better support to their tenants and promote the growth of the region in which they are located. Since regional growth is closely associated with groups of talented people, science parks carry out various activities at the company or individual level to attract and recruit talent. In order to understand how such activities have been and are being performed at Mjärdevi Science Park in Sweden, the authors highlight and analyse four talent-related cases. Their aim is to identify how talent can be attracted or recruited and to consider the stakeholders, their relationships and their motivations. The results confirm the importance to a science park of being close to a student community and of being connected to an international network with a well-recognized brand.

Keywords
board of students, incubators, science parks, Sweden, talent attraction, talent recruitment

Since science parks were first established in North America in the mid-20th century, the research and market aspects of their profiles, as well as their relationships with knowledge suppliers, innovative firms and the community, have evolved. In the late 1970s and early 1980s, U.S. policy initiatives such as the Bayh–Dole Act created favourable conditions for the formation of partnerships between universities and firms to commercialize the results of university research (Link and Scott, 2006). These developments encouraged the emergence of new parks in the United States, which have been used as models for science park development in other countries (Westhead, 1997).

According to the International Association of Science Parks and Areas of Innovation (IASP, 2016), a science park is:

> an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions.

Furthermore, Westhead (1997) states that science parks express the idea that scientific research leads to technological innovation and that parks ‘can provide the catalytic incubator environment for the transformation of “pure” research into production’ (Westhead, 1997: 46).

Colombo and Delmastro (2002: 1107) define a science park as a:

> . . . property-based initiative which: (a) has formal operational links with centres of knowledge creation, such as universities and (public and/or private) research centres; (b) is designed to encourage the formation and growth of innovative (generally science-based) businesses; and (c) has a management function which is actively engaged in the transfer of technology and business skills to ‘customer’ organizations.

Several studies, such as those by Hommen et al. (2006) and Lindelöf and Löfsten (2002), have shown that science parks are strong leaders in supporting and promoting the growth both of their tenants and of the surrounding region. Carrying out their leadership role in regional development, science parks make important contributions in several areas; however, the main focus of their operations concerns the management of human capital. Glaeser et al. (1995) sought to understand why cities grow, and the empirical data they collected linked regional growth with human capital development. Lucas (1988) too claims that regional development derives from groups of talented people working in the region. Florida (2003) argues that the existence of talent is a major growth factor and that existing talent is

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responsible for the continuing flow of new talent into a region. Thus, science parks possess a magnet-like attraction for this special class of people who have the ability to drive the growth of an entire region.

However, the concept of talent lacks a coherent and consistent definition. What talent is, or even who might be considered talented, remain nebulous notions. Tansley (2011) presents several definitions of talent which she then applies to talent management, considering various aspects – grammatical, historical and geographical, for example – in her analysis. Gallardo-Gallardo et al. (2013), attempting a wide definition of talent, suggest splitting the definition into two complementary parts, the first covering individuals who are 'high performers' or have 'high potential' and the second covering talent in terms of an individual's special qualities, which can be 'innate abilities, acquired skills, knowledge, competencies, and attitudes that cause a person to achieve outstanding results in a particular context' (Gallardo-Gallardo et al., 2013: 297). In a complementary fashion, Florida (2012) suggests that the work in which the individual has been involved is a valuable source of information about his or her characteristics and the types of skills and knowledge that he or she has. Merging these concepts allows us to build a useful definition of talent that our study can apply. Thus, for the purposes of this study we consider that a talented person is an individual who has certain skills, experiences and qualities that are significant for the growth and development of the science park.

Previous literature has focused mainly on the roles that science parks play in stimulating regional growth and that talent plays in making it happen successfully. The 'science' of innovative and entrepreneurial processes, especially as related to science parks, has been thoroughly researched. But to our knowledge, these studies have presented only a superficial understanding of the links between regional growth, talent and the processes of science parks and how they are related to the attraction and development of such talent. Thus, to expand the field in a new direction, one of our theses here is that the success of science parks is directly related to their ability to attract and develop talent. A secondary thesis is that there is a symbiotic relationship between science and talent: One cannot exist without the other.

Undoubtedly, science parks, in their development process, are directly or indirectly involved in the attraction and retention of different types of talent. Since few studies have addressed this topic, our study focuses on (a) the activities science parks undertake to stimulate the attraction and retention of talent, (b) how and why these activities are being developed and (c) the policy implications of such activities for science park management.

Method and data

To address the research questions, we decided to perform a longitudinal case study on the motivations for and activities related to the attraction and development of talent at Mjärdevi Science Park (MSP). Located southwest of Stockholm in Linköping, Sweden's fifth largest city, MSP was founded in 1984. We chose MSP for three main reasons: (a) it has been operating for over 30 years, during which it has seen success and failure, so the data are rich; (b) the MSP story includes cases dealing with talent recruitment and (c) we have good access to data, in part because it is local.

We decided to use a case study approach because it is, in general, the most suitable method for investigating 'a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident' (Yin, 2003: 13). Moreover, Eisenhardt and Graebner (2007) point out the relevance of case study methodology in building theories and claim that this method is one of the best 'of the bridges from rich qualitative evidence to mainstream deductive research' (Eisenhardt and Graebner, 2007: 25).

As we explain above, science parks are less successful without talent but the literature in general seems to address the subject of science parks and talent resource management only as an afterthought. We decided to explore this research gap because it is crucial that science park managers and tenants understand how talent can be attracted and developed in order to improve science park policies and the chances of achieving success.

We based this study on previous studies that have taken a regional perspective and included science parks as one of the acting agents (Albahari et al., 2011; Etzkowitz and Klofsten, 2005; Klofsten et al., 1999; Lindelöf and Löfsten, 2002) and on studies that have explored science park development (Hommen et al., 2006; Wessner, 2009). We also carried out an extensive literature review of talent concepts, with the aim of understanding (a) who constitutes a talent resource and (b) what qualities or competences (skills and knowledge) an individual must have to be considered a talented person. We then began to explore the relationships between talent and science parks in order to determine which main stakeholders were involved in the attraction and development processes of talent (Florida, 1999, 2003, 2012; Gabe et al., 2012; Gagné, 2004, 2010; Gallardo-Gallardo et al., 2013; Mellander and Florida, 2011; Tansley, 2011). We took advantage of the fact that one of our co-authors is a former CEO of MSP; he had been an active observer and was able to describe the development of the park from before its founding in 1984 until recently. We also conducted interviews with the CEO of the LEAD business incubator (discussed in detail later) to discover possible missing information about its processes of attracting talent. Secondary data were collected by gathering information from associated scientific papers, as listed above, from institutional documentation such as web pages and press conferences, and from a master's thesis (Denisova and Goylo, 2012). Finally, three key people who had had an active role in the development of MSP validated the case. These people had, directly or indirectly, at least 10 years of working experience with MSP's business and development activities, stakeholder relationship management and internationalization.

The collected data were subdivided into four periods: inception, start-up and early development, expansion and development and continuous growth and development. For each period, we highlighted what was expected to be achieved (goals), who was involved, what and how relationships were created among the stakeholders (structures and processes), and what activities MSP actively conducted (MSP-managed activities). Table 1 summarizes these goals, structures, processes and managed activities.

We extracted four cases of talent attraction and development from the MSP case. Each talent case illustrates different aspects of talent activities:

- MSP Office coordinates all types of connection (including faculty and students) with the University. It also facilitates entrepreneurs' access to the Park's services. The connections with the University led to an increased number of connections with students and faculty, an improved gender balance and overall stronger collaboration with the University. Activities emerging from this initiative boosted the number of firms and employees in the Park and assisted its long-term development.
- The Soft Landing project approaches international firms and organizations to establish in the Park. The project has attracted around 10 firms to the Park, mainly from India, the United States, Germany and Finland. As a result, MSP has become much better known internationally.
- The LEAD business incubator recruits leaders, managers and others to complement start-up teams. Over 10 years, LEAD has attracted 10 CEOs, 100 board members and about 30 strategic personnel to their tenants.
- The Shadow Board connects the Park to the University's students. The Board, composed equally of men and women, has brought MSP closer to students. Among the many new ideas generated, the meeting place creActive has been a notable success, in both the number and the variety of visitors it has attracted. Many students use the meeting place and are becoming well connected to the Park.

In-depth data analysis of each period allowed us to group the concepts and organize them into patterns of activities related to the attraction or development of talent (cf. Gioia et al., 2013). Longitudinal analysis in accordance with the research questions identified patterns in science park activities that were related to talent attraction and recruitment.

The case of MSP

During its 30-plus years of activity, MSP has become an increasingly important actor in the region's economy. The Park sits on a 70-ha parcel of land adjacent to Linköping University and is home to more than 300 technology-based firms, providing employment for around 6000 people. The majority of these firms are small, but larger tenants, such as Arris, Autoliv, Ericsson, Flextronics, IFS and Sectra, also reside in the Park. MSP firms together form an agglomerate of numerous competence areas, including visualization, modelling and simulation, connectivity and mobile broadband, vehicle safety and security systems. The Park offers tenants access to business advice, funding and internationalization opportunities, while maintaining a focus on the attraction of talent. The Park's broad base of support and activities aims to encourage and stimulate growth and success among its businesses, regardless of size or development stage.

Development of MSP

To explore why and how talent attraction activities are created and developed, we drew up a model of MSP's development and growth, as described in the methods section of this article (see Table 1). The four talent cases are highlighted in the timeline of MSP's development. The talent cases exemplify in various ways how MSP organizes activities that target recruitment and retention of talent in the Park.

Inception – the drive to build a new science park

A proposed cut in government subsidies at the end of the 1970s threatened the future of Swedish aerospace and defence company SAAB, one of the largest employers in the region, raising the possibility of serious economic problems in Linköping. In response to the economic climate, Linköping Municipality, Linköping University and SAAB management came together as key stakeholders and held a series of meetings to discuss ways of ensuring continuity in regional development.

This was a time when major universities in the United States and Europe were becoming increasingly proactive in the development of their regions. Together with regional management, universities were encouraging spin-off firms to exploit the new technology emerging from university research. To support such exploitation, regional governments were starting up incubators and science parks (Etzkowitz and Klofsten, 2005; Jones-Evans et al., 1999). In keeping with this trend, Linköping Municipality established Technology Village in the centrally located Valla industrial area. The incubator offered its tenants only simple administrative services and facilities, but it was undoubtedly an important precursor to the construction of MSP.

Start-up and early development – the founding of MSP

Technology Village was growing rapidly, but it soon became clear that more specific operational support, as

Table 1. The development of Mjärdevi Science Park.

	Inception, 1983	Start-up and early development, 1984–1993	Expansion and development, 1994–2000	Continuous growth and development, 2001–
Goals	Develop a new economic base for the region with a focus on the knowledge economy	Open up a geographical area adjacent to the Linköping University campus to construct a new science park Create a critical mass of new firms and attract strong anchor tenants Create a strong international brand for the science park	Increase the domain of MSP to become an internationally recognized player Develop more efficient services (including hard and soft resources) for tenants to match their real needs	Establish closer contacts with university students Expand the domain of MSP, with a strong focus on function
Structures and processes	Founds informal triple helix-type collaboration between actors such as the university, the municipality and firms Identifies key stakeholders Establishes collaboration Utilizes academic resources emerging from the university and surrounding environment	Faces and manages collaborative challenges between key stakeholders Conducts discussions on the general strategy of the science park: for example, on branding; which firms to target; and management of the park, talent and other resources Creates a package of services, provided either by the science park itself or in collaboration with external actors offering complementary resources Encounters its first crisis (1989–1992): a property stakeholder crisis. As a result, new property developers enter the science park.	Takes an active role in regional development. *Site Selection* magazine ranks MSP as the ninth fastest growing park in the world As a first step towards a regional innovation system, takes part in the development of the Growlink network, which gives entrepreneurs easier access to resources Venture capital companies were placed at the Park, for example, Novare Capital Offers to the University an office for collaboration and commercialization of research at the Park Establishes a childcare centre with English-speaking staff	Becomes home to the LEAD incubator, a merger of the Mjärdevi Business Incubator and the Norrköping Incubator from Norrköping Science Park Becomes home to the Innovation Office, newly created by the university Faces its second crisis (2001–2003): the IT crisis. Major firms downsize or move out, leaving unused space in the Park Sees the rise of new opportunities due to the crisis: new firms, new collaborations and new technological clusters
MSP-managed activities	Establishment of an incubator, Technology Village (TV), in the centre of Linköping to support university spin-offs. TV offered simple services to its tenants and was the first step in the development of what would become the Mjärdevi Science Park	Relocation of some TV firms to the new science park – Mjärdevi Science Park (MSP). Establishment of a city-owned organization at MSP for managing Park operations Collaboration between MSP and Linköping to create an informal incubator based on the university's entrepreneurship programme (ENP)	Establishment of Mjärdevi Business Incubator. Active participation in the International Association of Science Parks, which MSP used to build a sister park network Implementation of a wide area network in the Park Establishment of the HomeCom Linköping project	Cooperation between MSP and university students on matchmaking for career development Launch of the Soft Landing programme to bring international companies to MSP and help established firms reach new markets Start-up of creActive, a meeting place and activity arena primarily for students and firms, but also others Start-up of a Shadow Board for accessing students' visions on the development of the Park Participation by MSP in activities development for a new park in Linköping

well as consultants and financial resources, were needed. The shortage of people with the specific skills necessary to support the development of spin-off firms made it important to find ways of attracting such professionals. Moreover, many students completing their studies each year meant that, if the region could not provide attractive employment, valuable knowledge would be leaving in an annual 'drain'. For these reasons, the idea of building a science park to improve regional attractiveness became increasingly attractive. A science park would gather local talent and attract the outside skills that could support regional development.

In 1984, MSP formally opened its doors in an area adjacent to the University, at a distance of 5 km from the centre of the municipality. To offer better support and higher integration with the University, some of the Technology Village firms were relocated to MSP and an informal network, Small Business Development in Linköping (SMIL), was founded. SMIL is composed primarily of entrepreneurs and it supports local firms in the conversion of their ideas into successful, feasible businesses. By the end of 1984, MSP had six firms with 150 employees on site. In addition to small firms and spin-offs, MSP became interesting to larger companies like Ericsson and Nokia, which established the Ericsson Application Centre there in 1987 and Nokia Data in 1989. Companies of this size and importance are essential for attracting other firms, skilled professionals and financial resources.

In the early 1990s, Sweden suffered a minor recession which included a financial and property crisis, so, to fill empty space, Mjärdevi landowners allowed any firm to rent their property, regardless of operational focus. Because of the potential effects of this decision on MSP's growth, the key stakeholders held meetings to reach a consensus on the type of business profile required at MSP and it became clearer as a result which tenants it should attract. When MSP reached 49 firms and 1000 employees, it launched a new limited company responsible for management, development and marketing: MSP Office.

Expansion and development – a solid foundation for growth

In 1994, Linköping University launched the Centre of Innovation and Entrepreneurship with the mandate to explore and carry out the integration of entrepreneurial activities with research and education activities. One of the first programmes launched was the Entrepreneur and New Business Development Program or ENP (Klofsten and Lundmark, 2016). MSP and the University created a new 'informal' incubator based on this entrepreneurship programme, and it later became Mjärdevi Business Incubator. With solid growth year after year, MSP had become well established: Its international network was growing, and the number of start-ups, firms and employees continued to increase. The first group of start-ups concluded the pre-incubation programme in 1996, and MSP then had 110 firms, with around 3000 employees.

MSP had become an important regional performer and actively participated in drawing up an organizational description that defined the roles and activities of the key stakeholders. To improve its service offering and to optimize resource use, MSP and its stakeholders developed a regional network, Growlink, whose members helped one another to access adequate funding and provided advice and guidance on all phases of business development. As a result, entrepreneurs could more easily gain access to regional resources.

On the 15th anniversary of MSP in 1999, the University launched the SMIL Entrepreneurship School, which offered five theoretical and practical courses in technology-based and knowledge-based entrepreneurship. MSP also became very active in the International Association of Science Parks and Areas of Innovation and used the Association's network to construct a sister park network. The expansion years of MSP also included welcoming venture capital companies to the site, a childcare centre with English-speaking staff and a University office for collaboration and research commercialization.

Infrastructure kept pace with Park growth through implementation of a wide area network. HomeCom Linköping was established to support the research and development of products that simplified daily tasks for people in their everyday lives; this project was so successful that MSP was selected to speak on behalf of the region about its Centre of Excellence in Home Communications technology. Mjärdevi Business Incubator was officially launched in this period and, for the first time, the Park had an incubator providing all the features and facilities necessary for hosting technology-based start-ups. By the turn of the century, MSP had 150 firms and 5500 employees and was still growing.

Continuous growth and development – expanding into the future

The recession in the early years of 2000 severely damaged the IT industry and also affected small businesses. During 2000 and 2001, the number of MSP employees declined for the first time and Park development underwent a downturn. For example, Ericsson shed over 1600 and Nokia Home Communication close to 200 employees. Despite the crisis, Sectra and Kreatel, two University spin-offs, relocated to a newly constructed building and Intentia, with 250 employees, moved into the former Nokia building. The number of new firms moving into MSP was twice the number leaving. Furthermore, former employees of Nokia created several new firms, transforming what could have been a catastrophe into new opportunities.

While the crisis continued, it became clear that establishing solid strategies to support the continuous growth of the Park was even more critical. Research areas had to be re-evaluated and new ones developed. A working group comprised 60 firms (including SAAB), the Östergötland County Administration Board, Region Östergötland, trade unions, Linköping University and R&D organizations, collaborated on the preparation of an application to the Swedish Agency for Innovation Systems (VINNOVA). VINNOVA subsequently approved the plan, *New Tools for Life*, to sponsor new research in life science technologies. The research lines at the University thus had to be restructured and aligned with this new orientation. The University also created an Innovation Office to handle issues related to the commercialization of intellectual property.

The necessity of attracting new, important firms was still vital for achieving consistent growth, so in 2005 the Board of MSP decided to implement Soft Landing, a service for supporting firms wishing to enter MSP. Two years later, support processes for new firms were further improved when the Mjärdevi Business Incubator and Norrköping Incubator were combined into a single new incubator – LEAD. On its 25th anniversary in 2009, after 4 years of solid expansion, MSP affirmed its self-sustained growth. It continued to invest in its firms and talents, providing the required support and integrating them into MSP processes; for instance, with the establishment of a Shadow Board of Directors in 2011, MSP became one of the first science parks to have a group of college students participating in its decisions.

creActive, a meeting place and activity arena, opened in 2013 to offer premises for use primarily by students and firms but also others. Rooms and facilities are free of charge, but it is also possible to reserve a room for a voluntary donation. Start-ups find this space very useful because they can access local infrastructure in an inspiring environment while still being able to establish contact with students and other firms. After 32 years, MSP has around 300 firms and more than 6000 employees.

Talent case 1: MSP Office

From the time the Mjärdevi area 'opened' in 1984, various bodies had handled issues concerning establishment, networking and development. The Technology Transfer Office at Linköping University and the Office for Trade and Industry in Linköping Municipality were the main organizations that, alone or together, would take responsibility. This way of working, however, created an ambiguity for both the tenants and other actors and the lack of clarity gradually led to the formation of MSP Office in 1993. Linköping Municipality has always been its sole owner, but the board of MSP Office has been made up of members from trade and industry, the University and the Municipality. From the beginning, the company's task was to coordinate activities that generated growth, supported new businesses, strengthened branding, and attracted entrepreneurial talent and positions. By building a large network of regional, national and international contacts, MSP put itself on the international map, and this helped to attract not only new firms (including international ones) but also new people to the area. The end result was that MSP had a firm working on its brand, which also helped MSP firms to gain access to other markets. It also helped foreign companies to slide easily into the Swedish system through the single-door entry, MSP Office.

The demand for engineers has grown steadily, and when a shortage of supply became the greatest single obstacle to growth, the focus shifted increasingly to Linköping University students. There was a clear need to create better, more precise methods of communication. The rapid development of social media provided opportunities for improvement in this respect: Hiring staff to work more or less solely with social media was now relatively routine and MSP was no exception. Social media made the task of describing the firms and jobs linked with the Park very much easier and contributed strongly to its attractiveness. Combined with the creActive activities, the work done by the Social Media Manager also facilitated the attraction of female students and international students. As a result, MSP had an increasing number of students visiting and using the creActive space who, in the process of doing so, became aware of the purpose and functions of MSP.

Communication was also extended and improved by the more open attitudes apparent in trade and industry, with investments in open innovation platforms and 'Hackathons', among other things. Increasingly rapid digitalization was also a strong factor in increasing the Park's attractiveness internationally: 'Born Global' thinkers make it easy for a country with a small population, like Sweden, to support firms that need to reach the rest of the world quickly. The growing number of new firms that have attracted the attention of and have been 'captured', or bought, by multinational players with their headquarters in Silicon Valley or elsewhere is evidence of the efficiency of the current communication channels. Such a 'drain', however, does not have to be negative, since it contributes to the international exposure of MSP and so yet more firms (and engineers) become interested in the Park.

Talent case 2 – Soft Landing

For many years, operations dedicated to Swedish start-ups was channelled through the incubator. The incubator offering was mainly targeted at entrepreneurs who were already in the Linköping region – and often at entrepreneurs with a link to Linköping University and its surrounding institutions (but also at people who chose to leave their employment to start a business on their own). In order for the Park to continue its growth, this model of development needed enhancing with new elements. MSP managers realized that Indian consulting companies were already providing services to some Swedish companies, so, in a proactive attempt to increase its diversity and attract more international companies, MSP took advantage of the fact that it had specialists with knowledge in international business and in 2004 began a trial operation called 'Soft Landing'.

From the outset, Soft Landing welcomed smaller foreign companies that wanted to test the Swedish and Scandinavian markets with an establishment at MSP. Interest was clearly exhibited when several IT consulting firms, primarily from India but also from Germany and Finland, tested the model. The Soft Landing programme subsequently received national recognition as a new means of attracting foreign companies. After only a few years, around 10 firms had gone through the programme, including some that were exclusively R&D-oriented firms, such as U.S. medical technology companies. Although the programme was not designed for a particular industry, software development companies and IT consulting were the businesses that benefited most from it.

As the programme grew, it added support for smaller MSP firms that wished to try new markets. This was done through, for example, an European Commission (EU) project in which Sweden (MSP), Finland (Aalto University), Estonia (Tallinn Science Park Technopol) and Latvia (Latvian Technological Centre) participated.

What did the offer consist of? For foreign companies that wanted to test the Swedish market, it included premises for 1 year at a reduced rate, free consultations in business law and accounting, HR services at a reduced cost, access to the normal MSP network and opportunities to make contacts at all MSP events. For those MSP firms that wished to take advantage of the Soft Landing programme to enter new markets, participation in MSP-like environments in other countries was offered, including help with market analyses and access to firms of interest.

With the launch of the Soft Landing programme, a structured effort in intercultural communication began. Information was gathered and made available on the differences between business cultures in various countries, how one should present oneself, and what it was important to consider when the time came to do business and establish a firm in a foreign market. This information facility was established with the help of Linköping University and with what today is Business Sweden, a national organization that works to support Swedish exports.

One of the consequences of Soft Landing was that MSP became widely known for its international efforts, which attracted people who wished to work with, and who had knowledge of, internationalization – and not only to firms in the programme but to business in general. Put simply, it was becoming common knowledge that the MSP firms were basically international in character and it became easier to recruit staff with special competence in internationalization.

After about 6 years of operation, although the Soft Landing programme was mothballed, foreign companies were still offered start-up assistance. The procedures for receiving international companies were being integrated into the operations of the Park and so the project could be ended gradually. Information and education concerning new markets were also continued at an undiminished pace.

Talent case 3 – LEAD Incubator

During its development, MSP's mandate to produce sustainable firms meant that it became involved either directly or indirectly with incubators. The first step was the building of an informal incubator in 1993. The idea for this development emerged when young entrepreneurs who had participated in the University's entrepreneurship programme required premises. This first incubator attempt was successful, and the Mjärdevi Business Incubator was formed. It later became part of the LEAD Incubator that is now owned by Linköping University.

LEAD is located at MSP, but the incubator has also outsourced some of its activities to Norrköping Science Park, adjacent to the University's Norrköping campus. An increasingly important and natural part of LEAD's activities is to assist its tenants to recruit leaders and other strategic personnel. Many of the firms admitted to the incubator have been started by entrepreneurs with scant experience of developing and leading a business. It is very common for young companies to start operating with a lack of professionals in certain positions and therefore they need support to access new or complementary talents. Moreover, firms often have a great need to supplement their staff with new employees, and important positions, such as a new CEO, board representatives or jobs requiring skills unique to the sector, sometimes need to be filled.

Over the years LEAD has achieved substantial results with the talent recruitment process for its tenants, having attracted about 10 CEOs, 100 board members (an average of 10 per year) and between 25 and 30 strategic personnel (about 3 per year). For two of the top tenants, this matchmaking was a turning point as they were able to bring, at the right time, the right professionals needed to address the shortcomings of the teams, allowing firms, instead of closing their doors, to continue operating. In other cases, the entry of a new CEO helped start-ups to grow into successful businesses. The recruitment process must, however, be conducted with great sensitivity, based on concrete need and in agreement with the firm – especially when it comes to the recruitment of a new leader. During talent recruitment, there is also established collaboration with other organizations in the region, which supplement the incubator's own network in the search for regional, national and, in some cases, international talent.

The headhunting process has now developed into an organized process, with its procedures and resources well defined. At the time of writing, LEAD is considering allocating one professional to work full-time on this activity. LEAD's managers believe that the ability to ensure an inflow of good projects to the incubator in the future is strongly linked with the ability to recruit talent.

Talent case 4 – the Shadow Board

Many Linköping University graduates leave the Linköping region. It has been that way for a long time, and many universities outside metropolitan areas experience the same phenomenon. At the same time, this problem presents an opportunity. Linköping 'owns' its students for 4–5 years and has the chance during that time to inform, influence and convince them to stay in the city and find their future employer or start their own firm there. Students have long been a subject of interest at MSP and this interest has grown in parallel with the need for technicians and engineers; the shortage of engineers has become perhaps the single greatest hindrance to firm growth.

What, then, can a science park do to help firms in their hunt for manpower? Naturally, the right channels are needed for distributing information, but much can be done through various projects and activities to interest students in business, and in the life and culture of a science park environment. MSP started one such effort with the goal of using a group of students from different educational disciplines to discover students' desires concerning their future workplace and working environment.

The MSP Board has traditionally been made up of experienced politicians and representatives from industry and the University, with an average age that is usually over, rather than under, 50. People of that age may, naturally, not be intimately acquainted with the thoughts of today's new graduates about their future. How then do we include those considerations in our daily operations? The response of MSP was to appoint a 'shadow' board comprised entirely of students. The idea was implemented in 2012: The selection process of students began with the dissemination of information about the opportunity to become part of a student board. Social media, posters, a newsletter and personal contacts were used to communicate with and invite students to join the project. The main goal of the selection process was to attract students from the widest possible range of disciplines and to achieve a 50–50 balance between males and females or as close to equality as possible. Interested students were asked to send in their CVs and explain why they wished to participate. The average number of candidates was about 25 per year, of whom 10–15 were selected for interview. In the end, eight students from different academic fields were offered the chance to participate for 1 year on the Shadow Board. As compensation for their time and effort, they would receive professional experience of board work.

Both boards had the same chairperson; that is, the chair of the MSP Board had the same duties on the Shadow Board. This simplified the flow of information between them, and there was in addition a joint strategy meeting each year. Another advantage was the dual flow of information, which meant that the students spread information on MSP and its work through their use of social media. They also brought students' desires and fresh ideas to the MSP management. This dual flow of information was and remains one of the most important contributions of the Shadow Board.

The Shadow Board dealt with the same issues as those an ordinary board would address, but it would often reach a different conclusion from the MSP Board, which was a great advantage for MSP's development. An example was the construction of the creActive arena: The proposal was at first rejected by the MSP Board, but the Shadow Board was able to demonstrate the benefits of having a meeting place in the Park, and so the project was ultimately approved and carried forward.

Over the years the Shadow Board project evolved considerably. After the first year, for example, changes were made in its working method: Instead of replacing the Board as a whole each year, only half its members are now replaced, so that there is greater continuity every year. In 2014, the Shadow Board was renamed as the Mjärdevi Student Board. Various efforts have also been made to achieve broader representation of different University programmes and a better gender distribution. For example, in 2015 students from the Norrköping campus were included to obtain a more regional perspective, and in 2016 MSP brought two students from exchange programmes to get more diversity in the group.

With the introduction of the Shadow Board, and several other student projects, MSP became known to Linköping University students in a completely new way. The firms' opportunities to recruit new graduates also increased. Even when students choose to leave Linköping, they take with them a positive impression of MSP and its firms.

Analysis and discussion

In the first-order analysis, we extracted from each case concepts related to the attraction or retention of talent (see also Gioia et al., 2013). We then correlated these concepts with theory and identified themes for a second-order analysis. Deeper analysis of the discovered themes led to aggregate dimensions of the second order. Finally, we developed data structures for analysis (Gioia et al., 2013: 21).

Science parks are organizations that involve many actors, and the quality of the links between them is an important factor in the attraction and retention of talent. Links between universities and firms, for example, can provide firms not only with technology from research but also with students at various levels as skilled workers

(Bienkowska and Klofsten, 2012; McAdam and McAdam, 2008). All MSP tenants work individually according to their interests and talent needs. MSP management, however, performs an important role in stimulating the attraction and retention of talent and, as the four cases demonstrate, uses many approaches to fulfil that role. To explore the underlying motivations and outcomes of these activities, we began by analysing the role of the University in talent recruitment, because two of the talent cases were linked directly to the University and its students (MSP Office and the Shadow Board). Next, we examined the roles of firms, both start-ups and well-established businesses, in the other two cases (Soft Landing and LEAD). In three cases, MSP management was the main actor, coordinating the activities, but in the fourth case the LEAD incubator appeared to be chiefly responsible for talent development. To meet the growing demand among tenant firms for new engineers, MSP looked at new ways of attracting prospective students to Linköping University. The management began to take advantage of social media to describe emerging opportunities at the Park. Spreading information via such channels was useful in attracting prospective students, but it was also useful in influencing students to consider remaining at the Park after graduation.

Communication 'is essential in building trust' (Spaeth and Törnström, 2012: 18) and so it was one of the most important tools for attracting and retaining talent at the Park. Through its large network of contacts – including regional, national and international actors – MSP's reputation grew internationally. Multinational players began to take notice and to buy up newly started firms. These events drew even more attention to the Park on the international scene, strengthening the MSP brand and consolidating its image as a suitable environment for business development. Open innovation concepts emerged first in business incubator environments and then in trade and industry. Park tenants found the environment favourable for sharing knowledge and developing a sustainable network of mutual support. Networks are an important factor in attracting and retaining firms and professionals who wish to work in an open innovation environment. Those who left the Park carried these concepts with them.

Following the bursting of the IT bubble, MSP shifted its focus to attracting foreign companies and developed Soft Landing, a programme designed to function on the international scene. For companies wishing to test Swedish and Scandinavian markets, this programme offered easy access at low cost compared with traditional means. Additionally, foreign firms received more benefits, such as coaching and access to the MSP network. The new firms brought new people and new ideas from abroad to the Park, effecting a renewal in local industry. Moreover, because the headquarters for these companies could be anywhere in the world, their contribution to the MSP brand was far-reaching, and the Park becomes known among many businesses and professionals whom it could not otherwise have reached.

As the programme grew, its focus became two pronged, the second prong a reverse of the first; it began to support the entry of its smaller tenants into international markets. Tenants now had the opportunity and support to grow consistently and remain in the Park. Thus, Soft Landing became also an important way of retaining firms and talents. With the success of Soft Landing, most MSP tenants became international in character, which required staff with a knowledge of working internationally. This talent had to be recruited, not just for the Soft Landing programme, but for the other Park tenants as well.

The LEAD incubator at MSP is 'dedicated to the support of emerging ventures' (Bergek and Norrman, 2008: 21), mainly University spin-offs. Considering that experienced professionals are important in helping young firms to reach the next stage in their growth, over time LEAD developed an internal process for assisting its tenants in their recruitment activities. A lack of senior talent in a young firm might be due to business inexperience or a sudden shortage, such as a requirement for a new CEO or manager, or for staff with sector-specific skills. Using its network and establishing new contacts with other regional organizations, LEAD works to find the best solution to the tenant's needs.

Over the years, MSP has shifted its focus from business to talent. The relevance of attracting and retaining talent has increased with digitalization. In this new situation, students at the University became an important element due to their potential with regard to firm creation and as employees in established tenant firms and for creative suggestions that could benefit Park development. With this in mind, MSP created a Shadow Board, as described in case 4 above. Besides representing the visions and desires of students, the student board members have also been agents in spreading information about MSP, above all through social media. Thus, the Park edged closer to its students, getting to know their real needs and communicating with other young people through the board members. Contact with students goes well beyond Park boundaries, reaching students and prospective students in other regions and countries and stimulating their interest in studying at the University.

The cases show that, to attract and retain talent, MSP has had to manage a large group of stakeholders, including Linköping Municipality, Linköping University, R&D organizations, VINNOVA, the LEAD incubator and its tenants, and established companies. They also demonstrate that changes in the perception of MSP managers concerning talent recruitment were vital; in other words, they understood that talent had to be recruited individually, rather than at the enterprise level.

To fulfil the promise of its efforts to attract and retain talent, MSP had first to develop processes that could reach both junior and senior resources. The creative mindset of young talent is important for firm growth and for academic activities at the University. Specific initiatives, such as the creActive arena, have served to facilitate access to young talent. Senior professionals, with their experience and knowledge, also have much to contribute in large companies and start-ups, or as university researchers. Besides the MSP management, LEAD plays an important role in attracting this type of talent for its tenants.

Second, the diversity of the sectors represented and of the amenities and services were powerful factors in influencing the flow of talent, domestic and international, to MSP.

Third, MSP took advantage of its extensive network of contacts, and of the Internet through social media, and worked hard to internationalize its brand and disseminate information about its services and structures, and the research opportunities for both junior and senior talent.

Conclusions

Science parks were developed to provide an environment conducive to emerging technology- and knowledge-intensive firms. Many studies have pointed out that parks offer not only physical facilities but also network resources, such as access to funding and exchange of knowledge between firms and organizations in the region (Arroyo-Vazquez and van der Sijde, 2008; Lindelöf and Löfsten, 2002). Not least, a pool of well-educated and specialized labour – a critical resource for the growth and development of firms – can be found at science parks (Ferguson and Olofsson, 2004). In this context, the University of Linköping has the role of a 'collector of talent' (Florida, 1999: 71), creating an inflow of talents into MSP. New researchers and students attracted by the University from abroad will be responsible for many new spin-offs, populating the incubator even further. The Shadow Board brings in the young mindset of the University's students to create new perspectives and directions for the development of the Park and its firms.

One important conclusion of our study is that, even though it may not be spelled out in their operational strategies, science parks, on their own or in cooperation with others, conduct many activities aimed at attracting and retaining various forms of talent. Those activities focused on firm-related activities include, for example, (a) attraction of management and key personnel for young and growing firms, (b) the creation of a platform for international firms to establish themselves in the park and (c) collaboration with higher education institutions. Traditionally, Higher Education Institutes (HEIs) have been considered as key actors for science parks, because, among other reasons, attracting researchers with viable, innovative ideas and technical skills is crucial for park tenants. It is therefore not surprising that MSP's managers established formal and informal relations with regional universities at an early stage in order to promote a natural exchange of scientific expertise and research results (see also Deeds et al., 2000). Establishing relations with students – and perhaps even more importantly, with researchers – has emerged during MSP's development as an essential activity for developing a source of future employees for park tenants. Above all, talent recruitment occurs at the individual level (see also Florida, 2003) – it is individuals who build a successful environment, not firms as such.

The study showed that, later in its development, MSP succeeded with relatively few resources in creating a good relationship with the student community. In doing so, it gained access to the thoughts and ideas of young individuals concerning their future working life and ascertained what factors were important in attracting students. As with the student-related activities, efforts to attract talent to fulfil the specific needs of tenant firms occurred somewhat later in the Park's development. Collaboration mechanisms, and who is involved in talent recruitment activities, change over time in science parks in accordance with the changing requirements of stakeholders and the outside world in general.

With regard to the successful recruitment and retention of talent, it is worth stressing the importance of creating an attractive environment, of developing a positive image of the park regionally, nationally and internationally. This aspect of managing the science park environment, even though it is difficult to describe empirically, reflects the importance of establishing a 'prestigious address' (Storey and Westhead, 1994) and of creating 'image effects' (Ferguson, 1999, cited in Ferguson and Olofsson, 2004: 5) to gain recognition through 'social signalling' (Felsenstein, 1994: 107), and 'socio-cognitive effects' (see also Wennberg and Lindqvist, 2010: 223). Such 'soft' factors are important considerations for managers seeking to recruit and retain talent at science parks.

Theoretical and practical implications

Talent recruitment at science parks is a multifaceted phenomenon. This study is based on four cases at one science park and it is highly likely that there are other forms of talent recruitment to be discovered. Future studies might focus on talent recruitment cases from completely different perspectives than those in this study. Other comparative case studies might examine both specific activities and the science park as a whole. Examples of potential research questions include the following. Does talent recruitment differ between various types of science parks? In what ways do science parks collaborate with their stakeholders in talent recruitment? Do science parks collaborate on talent recruitment? How do science parks recruit talent nationally and internationally? Knowledge generated in such case studies could then become the basis for a quantitatively oriented study of parks nationally and internationally.

Studies tend to generate implications that can serve as guidance for managers and co-workers in science parks who want to stimulate growth in their park and their region. The strength of a park's attraction is linked to its critical mass (see also Klofsten et al., 2015; Laur, 2015). This is especially true when talent must be tempted away from other regions. The offer of an alternative working place must include work that is interesting and challenging to entice people to risk a move. That is, there must be critical mass, especially when talent must be attracted from major metropolises to smaller towns. Naturally, critical mass varies depending on the size of the city and the park and also on the sector and area of competence. Closely linked with critical mass is branding. Talent prioritizes brands that are strong in their respective areas of knowledge and lifestyle. The brands of the city, the park and the firms will generate a selection of talent – and so creating a brand together with critical mass is extremely important.

Knowledge is perishable, and yesterday's knowledge may not be attractive tomorrow. Thus, attracting tomorrow's talent and professionals – for example, university students – should be the aim. In most cases, they are mobile and will gladly travel internationally. However, there are various ways for science parks to create relationships with the student community: a Shadow Board, the Internet and social media. Not only for firms in the park but for all who work with talent recruitment, the world is the market. Therefore, it is essential to take advantage of any opportunity to create international networks, contacts and entryways. With such an approach, firms are helped in their internationalization, which for most of them is now an absolute necessity for growth, and opportunities are created for attracting talent from around the world to help drive the science park forward.

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Science Parks and the Attraction of Talents: Activities and Challenges

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Abstract

This paper explores activities undertaken by Science Parks to attract talent for their tenants. Despite the importance of accessing talent, there are very few studies focusing on this research area. The data in this investigation comes from seven cases studies on talent attraction activities carried out by three Science Parks in Sweden. We show that the parks conduct many different activities to attract talent including headhunting key personnel for start-ups, organising establishment platforms for foreign companies, and facilitating the exchange of knowledge and talent with higher education institutions. Science Parks house companies of different sizes, ages, and business orientations and therefore, park managers should be sensitive to the real needs of tenant firms when performing talent attraction activities.

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Keywords

Science Park – talent attraction – Triple Helix – incubators – stakeholder – networking arenas

Arabic

تايدحتلاو ةطشنلا : بهاولما باطقتساو ةيملعلا تاعمجملا

Eduardo Cadorin, Magnus Klofsten, Alberto Albahari, Henry Etzkowitz

الملخص

فاشكتسا ةيهمأ نم غمرلا ىلع .بهاولما باطقتسا نم نكمتت تيح ةيملعلا تاعمجملا اهسرامت تيلا ةطشنلا ةقرولا هذه فشكتست
ةطشنأ نع لقاح تاسارد عبسب تانايبلا قلعتت .لاجملا اذه في ثحبلا تمتها تيلا تاسارلدا نم ادج ليلق ددع دجوي هنإف بهاولما
باطقتسلا ةفلتخلما ةطشنلا نم ديدعلا ىدؤت تاعمجملا نأ ةسارلدا رهظت .ةيديوس ةيملع تاعمجم ةثلثب بهاولما باطقتسا
لىإ ةفاضلبا ,ةيبنجلا تاسسؤملا تاصنم ءاشنإ ; ةئدتبلما تاسسؤملا ةبسنلبا ةيساسأ تاراطإ لىع ثحبلا انهضمن ومب بهاولما
ةيراتجلا تاجهوتو رامعأو ماجحأ تاذ تكاشر ةيملعلا تاعمجملا مظنت .ليالعا يملعتلا تاسسؤمعم بهاولماو ةفرعلما لدابت ليهستل
مايقلا دنع مهيلإ ةمظنلا تاسسؤلما تاياجاح رابتعلا ينعب اوذخأي نأ تاعمجملا هتاه لىع ينلوؤسلا لىع هجوتي لكلذ ةفلتمخ
بهاولما باطقتسا ةطشنأب.

حيتافلما تاملكلا

لكيبشتلا , ينلخادتلا , نضاحلما , ةثلثلا حوارلما, بهاولما باطقتسا ,ةيملعلا تاعمجملا

Chinese

人才吸引和科学园：活动与挑战

Eduardo Cadorin, Magnus Klofsten, Alberto Albahari, Henry Etzkowitz

摘要

本文探讨科学园为其租户吸引人才所开展的活动。尽管获得人才非常重要，但很少有研究关注这一领域。我们的研究数据来自对瑞典三个科学园区开展人才吸引活动的七个案例研究。研究表明：科学园开展了许多不同活动以吸引人才，其中包括为初创企业寻找关键人员；为外国公司组织建立平台，以及促进与高等教育机构的知识和人才交流。科学园区拥有不同规模、年龄和商业定位的公司，因此，科学园管理者应该敏感地响应在租公司开展人才吸引活动的实际需求。

关键词

科学园、人才吸引、三螺旋、孵化器、利益相关者、网络竞技场

French

Les parcs scientifiques et l'attraction des talents: activités et défis

Cet article explore les activités entreprises par les parcs scientifiques afin d'attirer des talents. Malgré l'importance de la recherche des talents, très peu d'études y sont consacrées. Les données proviennent de sept études de cas sur des activités d'attraction de talents conduites par trois parcs scientifiques suédois. Nous démontrons que les parcs mènent des activités diverses et variées afin d'attirer les talents, dont la recherche de personnel clé pour les start-ups, l'organisation de plateformes d'établissement pour les entreprises étrangères, et la facilitation d'échanges du savoir et de talents avec les établissements d'enseignement supérieur. Les parcs scientifiques hébergent des entreprises de tailles, d'âges et d'orientations divers; par conséquent, les gestionnaires de parc doivent être attentifs aux besoins réels des entreprises locataires lorsqu'ils exercent des activités d'attraction de talents.

Mots-clés

parcs scientifiques, attraction des talents, Triple Hélice, incubateurs, actionnaires, arènes de réseautage

Portuguese

Parques científicos e a atração de talentos: atividades e desafios

Eduardo Cadorin, Magnus Klofsten, Alberto Albahari, Henry Etzkowitz

Resumo

O presente artigo explora atividades que parques científicos realizam a fim de atrair talentos para suas empresas inqulinas Apesar da importância de aceder talentos, há muito poucos estudos que enfoquem nesta área de pesquisa. Os dados são oriundos de sete casos de estudo de atividades de recrutamento de talentos realizadas por três parques científicos suecos. Mostramos que parques conduzem várias atividades diferentes com o intuito de atrair talentos, o que inclui recrutamento de profissionais-chave para startups, organização de plataformas de estabelecimento para empresas estrangeiras, bem como, facilitação e transferência de conhecimento e talentos com Instituições de Ensino Superior. Parques científicos abrigam companhias de diferentes tamanhos, tempo de atuação no mercado e orientação comercial e, portanto, gerentes de parques devem ser sensíveis às reais necessidades de suas empresas inquilinas ao realizar atividades de atração de talentos.

Palavras-chave

Parques científicos, atração de talentos, Hélice Tríplice, incubadoras, *stakeholder,* arenas de *networking*

Russian

Научные парки и привлечение талантов: инициативы и вызовы

Эдуардо Кадорин, Магнус Клофстен, Альберто Альбахари, Генри Ицковиц

Аннотация

В настоящей статье рассматриваются инициативы, которые реализуются научными парками для привлечения персонала в компании. Несмотря на важность привлечения талантов, очень малое число исследований посвящено данной теме. В исследовании рассмотрены семь практических проектов по привлечению кадров, реализованных в трех шведских научных парках. Мы покажем, что парками проработано множество различных стратегий в сфере привлечение персонала, которые включают поиск кандидатов на ключевые позиции в стартапах; организация стратегических платформ для иностранных компаний; также стимулирование обмена знаниями и кадрами с Институтами высшего образования. Резиденты научных парков различаются размерами, возрастом и сферой деятельности, поэтому руководству парков следует внимательно относиться к потребностям компаний при реализации программ привлечения талантов.

Ключевые слова

Научный парк, привлечение талантов, Тройная спираль, инкубаторы, акционеры, сетевые взаимодействия

Spanish

Parques Cientificos y la attración de talentos : actividades y desafíos

Resumen

En este artículo se exploran las actividades llevadas a cabo desde los parques científicos para atraer el talento para sus empresas residentes. A pesar de la importancia de acceder al talento, hay muy pocos estudios que se centren en este área de investigación. Los datos vienen de siete casos de estudio sobre actividades de atracción de talento llevadas a cabo en tres parques científicos suecos. Se demuestra que los parques articulan distintas actividades para captar talento, entre las que se incluyen identificar y reclutar personas clave para las "start-ups", organizar plataformas de aterrizaje para o establecimiento para empresas extranjeras, así como facilitar el intercambio de conocimientos y talento con instituciones de educación superior. Los parques científicos acogen empresas de diversos tamaños, edades y orientación empresarial por lo que las entidades de gestión de los parques deberían considerar responder a las necesidades reales de sus residedentes en los que concierne a las actividades de atracción de talento

Palabras clave

Parques Científicos y Tecnológicos, atracción de talento, Triple Hélice, incubadoras, grupos de interés, networking arenas

1 Introduction

Science Parks are policy-driven agglomerations whose management function is to actively engage in supporting the formation and growth of on-site technology and knowledge-based firms (Huang et al. 2012; Albahari et al. 2018a). There are different ways of describing Science Parks, although the definition by the International Association of Science Parks and Areas of Innovation (IASP), which is the one we consider for this study, is frequently used (Colombo and Delmastro 2002; Fukugawa 2006):

> *"Science Park is an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions"* (IASP 2017).

Over the years, Science Parks have been transformed from a single-purpose organizational model based on land tenancy[1] into an interactive, multifaceted organizational model with a more complex set of roles and relationships (Etzkowitz and Zhou 2018). To meet their objectives, Science Parks provide value-added services such as office space and facilities, but also supports the flow of knowledge and talent between universities and park companies (Bellavista and Sanz 2009). Studies highlight that one of the most valuable service that Science Parks provide for tenants are the links to universities and access to various academic talent (Colombo and Delmastro 2002; Fukugawa 2006). Moreover, Albahari et al. (2018b) show that the supply of soft value-added resources (process-oriented) is highly related to access to key experts, mentors, and entrepreneurs who are crucial for the growth and development of firms. To successfully connect with such individuals, companies have transformed their human resource management processes into a new strategic level called talent management, which aims to "attract, develop, motivate and retain talent" (Thunnissen et al. 2013, p. 1752). Indeed, a factor differentiating companies and marking one as more competitive than another lies mainly in the human capital resources (Holland et al. 2007).

Talent is considered a crucial human resource for the development and growth of companies (Barney 1991; Holland et al. 2007). Nevertheless, there is no consensus on how talent should be defined, and the meaning of talent within the human resource context is often taken for granted (Gallardo-Gallardo et al. 2013; Mcdonnell et al. 2017). Perhaps the challenge to find a precise definition of talent is because it is a subjective concept with many potential interpretations and meanings for those who are using it and the context they are operating in when studying the phenomenon (Tansley 2011; Florida 2012). For purposes of this paper, we concur with the following definition since it places the individual front and centre as talent and key actor in the development and performance of organisations,

> *"Talent consists of those individuals who can make a difference to organisational performance, either through their immediate contribution or in the*

1 Called by some authors as 'firm hotels' (Löfsten and Lindelöf 2002, p. 864) in a pejorative sense.

> *longer-term by demonstrating the highest levels of potential"* (Chartered Institute of Personnel and Development 2007, p. 3)

Thus, talents are those who because of their skills, knowledge, creativity, professional competence, communication and leadership ability (Saddozai et al. 2017), are capable to add value to a company and take it to a higher level of performance – 'high performers', or even having the potential to become such agents of business transformation – 'high potentials' (Thunnissen et al. 2013; Mcdonnell et al. 2017). Salvat and Marcet use three knowledge-related categories to classify talent: i) theoretical knowledge; ii) know-how; and iii) discernment; and two talented-worker-factors for further differentiation: iv) readiness to act and v) engagement (Salvat and Marcet 2008).

While there is extensive literature on Science Parks, and the significance of attracting talent is well known, there is limited knowledge on the talent attraction activities that occur within existing parks (Koh et al. 2005). Moreover, we have little knowledge about how Science Parks organise and collaborate their talent attraction activities despite the importance of the subject.

This paper explores the following two research questions: *i*) what are the activities that Science Parks undertake in order to attract talent for their tenant companies? *ii*) What are the main challenges that the parks experience in this regard? Filling this knowledge gap will shed light on the mechanisms used by Science Parks to create value for tenant companies and it will highlight a number of policy implications related to talent attraction activities.

Following a presentation of the literature in Section 2, the third section describes the methodology adopted and the process of data collection for this study. Section 4 introduces the Science Parks under investigation and the talent case-studies involved, while Section 5 analyses and discusses networking, and the supportive and integrative activities used in talent attraction in the parks. Section 6 examines the results, provides conclusions based on the evidence, and notes the paper's contributions. The final part proposes policy implications and future research.

2 Literature Review

The debate on Science Park's effectiveness as a development and innovation policy tool is still open. Yet many empirical studies have demonstrated that being located in a Science Park may have a positive effect on tenants' performance. Positive impacts have been found in terms of sales growth (Löfsten and Lindelöf 2002, 2003), employment growth (Colombo and Delmastro 2002;

Löfsten and Lindelöf 2002, 2003) innovation output (Siegel et al. 2003; Squicciarini 2008, 2009; Huang et al. 2012; Vásquez-Urriago et al. 2014), and R&D productivity (Siegel et al. 2003; Yang et al. 2009).

A recent theme in the literature on Science Parks takes into consideration parks' heterogeneity, recognising that some parks work better than others in generating value for tenants (Albahari et al. 2017, 2018a). In line with this, some authors have attempted to understand how Science Parks create value for tenants, something which is still unclear (Albahari et al. 2018b). A common view is that an essential feature of every successful Science Park is the provision of services by parks' management and in particular, it is thought that fostering creation and development in young firms through services related to financial and marketing issues, is of key importance (Storey and Tether 1998; Westhead and Batstone 1998; Löfsten and Lindelöf 2003).

In pursuit of development and growth, companies have developed a new strategic level in human resource management called talent management focusing on a selected group of people rather than on workers in general (Saddozai et al. 2017). Managing talent should not be the ultimate goal, but rather it is a by-product as managerial activities that develop employees or try to achieve specific levels of turnover. The core of talent management is to anticipate the demand for a particular human resource and then establish a plan to satisfy it (Cappelli 2008). Talent management is "an integrated set of processes, programs, and cultural norms in an organization designed and implemented to attract, develop, deploy, and retain talent to achieve strategic objectives and meet future business needs" (Silzer and Dowell 2010, p. 18). Theoretically, talent management services may be a relevant component offered by Science Parks and designed to make an essential contribution to tenant's talent management practices.

Proper talent management is a critical determinant of organisational success (Ashton and Morton 2005; Nijs et al. 2014). It can be a mechanism through which knowledge resources can be exploited to enhance firm performance (Chadee and Raman 2012). Firms seeking to improve their talent management practices could benefit, in particular, from adopting a collaborative network approach, which can readily emerge within a Science Park setting (Hu 2008; Schweer et al. 2012). Both newer and more established tenant firms could benefit from talent management actions promoted by the Science Park management. Younger firms, as start-ups, are often more reliant on the park's support when it comes to recruiting talent (Phan et al. 2005). Compact start-up teams sometimes lack members with specific expertise, e.g. managers and CEOs (Bøllingtoft and Ulhøi 2005). Therefore, the Science Park may support them in their search for professionals who have the required knowledge and background, and who come with a profile compatible with other members of the team (Phan et al. 2005; Albahari et al. 2018b). In contrast, mature companies tend to have more consolidated human resource management processes and therefore are more often able to engage independently in talent attraction activities (Cappelli 2008). Still, since older companies "require a broader array of talents" (Siegel et al. 1993, p. 170), the Science Park and its likely proximity to a university with a continual flow of graduates, can become the primary provider of talent and contribute to the talent attraction processes of these older companies (Florida 1999; Gibb and Hannon 2006; Etzkowitz 2008).

According to Engel et al. (2018), firms of all maturity levels as well as entrepreneurs, want to reside close to other firms, universities, and research centres. Some studies have demonstrated that Science Parks encourage the formation of links between local universities and tenants, which often results in the recruitment of university graduates (Felsenstein 1994; Westhead and Storey 1995; Vedovello 1997; Colombo and Delmastro 2002; Fukugawa 2006). Even so, the flow of talent from universities to parks' tenants is not necessarily a spontaneous process (Cadorin et al. 2017). It is up to the parks to provide an environment with career and individual development opportunities that can positively contribute to companies in their talent attraction processes. In fact, talents are mobile people, who seek out places where they feel encouraged to grow professionally and where they will have an opportunity to work together with other talents (Florida 1999). Additionally, the brand and the prestigious address of the park also contribute to creating a favourable scenario for attracting talent (Storey and Westhead 1994).

The topic of proper talent management and the potential impact of Science Parks on tenants' talent management practices, has received scant attention in the literature. Koh et al. (2005) found in their study of Singaporean Science Parks that the presence of talent attraction activities is a crucial ingredient behind the success of the parks. Cadorin et al. (2017) demonstrated how Science Parks undertake a number of different talent attraction activities from strategic recruitment within start-ups to providing arenas where people meet to exchange knowledge and networks.

To summarise, Science Parks are organisations that provide infrastructure and services to support the development of their tenant companies (Colombo and Delmastro 2002). Among the services offered by Science Parks, activities to attract talent and to support tenants in their talent management activities is something new in the field of park management (Cadorin et al. 2017). Talent-related activities performed by parks are in line with those who advocate a more hands-on role for parks' management (Westhead and Batstone 1998; Löfsten and Lindelöf 2002).

3 Method and Data

Our study comprises seven different talent-attraction cases (Table 1) that have emerged within three Science Parks in Sweden: Ideon Science Park (ISP), Lindholmen Science Park (LSP) and Science Park Mjärdevi (SPM) (Table 2).

We begin with SPM, an internationally renowned park. Having been operating for over 30 years, there is a large amount of available data accessible to the researcher including stories of success and failure in talent attraction. Both ISP and LSP came to our attention during interviews with representatives of SPM, which led us to conduct an in-depth study of their websites to identify activities potentially related to talent attraction. The choice of these three Science Parks situated in one country made it possible to illustrate a broad spectrum of talent attraction activities in Science Parks with similar characteristics.

We built on the method of case study analysis in line with Eisenhardt and Graebner who have written (2007, p. 25): "A major reason for the popularity and relevance of theory building from case studies is that it is one of the best (if not the best) of the bridges from rich qualitative evidence to mainstream deductive research." The case study method allowed us to understand the processes behind the emergence of talent attraction activities in Science Parks. We could study the key people involved, the context in what the activity is operating in and the observed outcomes of each activity (Yin 2003; Gioia et al. 2013).

We generated the table for conducting interviews by means of a progressive refinement process until we obtained the final version. We listed the main information needed from each park, noting that they all shared similar characteristics, such as age of park, orientation and – being located in the same country – same legislation and same culture. Once defined, the table was considered complete and was used in all interviews.

Before performing the interviews, we set up a panel of key individuals, such as former and current parks CEO's, incubator managers, and project leaders of talent activities that over time have been in the management and implementation of the Science Parks' administrations (see Appendix). The rationale behind the interviews was to get leads on potential cases, acquire historical data, verify the content validity, and receive feedback on the design and development of our study (Florin et al. 2007). As this study aimed to obtain the Science Park's perspective, we did not interview any member of the tenant companies.

Data collection for the study was done through semi-structured interviews with panel members as well as with new individuals suggested by our respondents, for example, managers of incubators and event managers in parks. Complementary secondary sources were used as well, including research papers on the studied parks (Park 2002; Hommen et al. 2006; Kruse 2015; Albahari et al. 2018b). We also used various internal documents and reports provided to us, and the internet websites of the three Science Parks. We were able to note activities similar to Mjärdevi (SPM) in the other two parks, but the aim of this study was not to compare similar activities in different parks. It was to look at different talent activities performed in similar Science Parks.

The first interviews began in 2015, with most occurring in 2016. Together, the 13 personal interviews comprise around 25 hours. Additionally, 3 complementary telephone interviews were held with certain respondents, each lasting between 15–30 minutes. The initial interviews were held with the founding director of SPM, who had been CEO until 2013, which is to say, for the first 30 years of the park. This respondent was crucial to the success of the research project. We established a research relationship with the subject similar to the interactive research approach of Ellström et al., which fosters a two-way flow of information and knowledge between research and practice (Ellström et al. 2011).

4 Analysing and Discussing Talent Attraction in the Studied Parks

The studied Science Parks undertake many different activities to attract talent (Table 1). For example, Soft Landing focuses on attracting foreign companies while LEAD, seeks to recruit professionals to start-up tenants. For both businesses and incoming professionals, SPM Office and CEVT HR, offer services designed to support tenant development. Shadow Board and Tech Pilots promote integration between young talent and park stakeholders, and Ideon Meeting offers park tenants a physical space for expanding their network of talent contacts. The parks face a number of challenges when it comes to defining roles and developing models for collaboration with key stakeholders such as universities and municipalities. There is an overall perceived challenge of getting regional actors involved in talent attraction and it is thought that doing so will make for a potentially more efficient process. And there are some specific positive outcomes associated with Tech Pilots that have allowed firms to strengthen their competitiveness, develop new business networks, and learn how to be more attractive to young professionals.

4.1 *Networking Activities*

All three Science Parks perform activities that develop and strengthen their image with the aim of attracting talent. The mission is to get attention from a talented workforce on the regional, national and international markets. Ideon

TABLE 1 Seven talent cases

	Ideon Meeting (ISP)	SPM Office (SPM)	Soft Landing (SPM)	CEVT HR (LSP)	LEAD Incubator (SPM)	Tech Pilots (SPM)	Shadow Board (SPM)
Goals	Create a physical arena for attracting talent, competence, experience, and diversity to the park.	Develop the Science Park Mjärdevi brand and support the growth and development of SPM tenants.	Strengthen park diversity and increase the attraction of international companies.	Create a suitable environment for the development and growth of CEVT.	Supplement traditional incubator activities with the recruitment of the "right" professionals to LEAD start-ups.	Connect young talent and technology companies more closely with each other.	Access the mindset and ideas of young pre-professionals via contacts with university students.
Activities	Coordinate meetings, conferences, and technical visits, matching content to the audience.	Attract profession-als to SPM Office and develop efficient networks with SPM firms to	Conduct networking activities in the international arena to attract companies and professionals to the SPM.	Arrange joint talent attraction events. Set up network services that provide	Collaborate with venture teams to define ways of strengthening start-up management functions.	Conduct web campaigns to find 10 young individuals to become "Tech Pilots"	Form a group of university students to function in parallel with the formal park board.

TABLE 1 Seven talent cases (*cont.*)

	Ideon Meeting (ISP)	SPM Office (SPM)	Soft Landing (SPM)	CEVT HR (LSP)	LEAD Incubator (SPM)	Tech Pilots (SPM)	Shadow Board (SPM)
	Organize competence forums to offer park tenants new business opportunities. Promote events focused on the needs of universities and researchers. Rent rooms for specific needs.	better cope with their real needs. Disseminate information and opportunities to university researchers and students. Educate politicians about the roles that SPM could play in regional economic development. Speak at conferences and network, for example, with Swedish embassies, to create and develop national	Build a knowledge base on business cultures in different countries and arrange seminars to explain such differences to SPM firms.	support in areas such as immigration, housing, schools, and contacts with Swedish authorities. Mediate contacts between CEVT and Swedish universities in order to facilitate the recruitment of students and researchers as well as establish research links.	Via extensive networking, seek professionals who meet the "real" needs of LEAD tenants. Prepare for establishing a permanent in-house function in charge of recruitment processes.	of the 9 pre-selected firms. Give companies insight into their businesses through a web blog. Make use of social media to promote the project and the firms in the project. Conduct workshops and meetings to discuss talent issues and	Formulate a strategy for building relationships with the student collective. Support Shadow Board members as ambassadors to the student community. Plan ways to use various social media to reach students.

		and international networks.				other subjects related to the firms in the project. Compose a final report on firm and talent attraction issues.	
Challenges	Create an underst anding among stakeholders that networking activities not only cost but also generate revenue. Stay up to date in order to offer activities that fit the real needs of park tenants.	Attract high-profiled firms and professionals. Provide high-profiled business support to enhance firm access to new markets and support international aspirations.	Define the "right" opportunities for international companies to enter the park. Building image related to the park but also the region.	Support CEVT in its search for competence that will help it grow and develop. Assist CEVT to find the right blend of Chinese and European managers.	Find talent that complements talented entrepreneurs. Increase the involvement of regional actors to make talent recruitment more efficient.	Find and select talented youth. Adapt companies to match the real needs of young talent. Overcome barriers of sharing	Reach students in all university faculties. Attract the attention of the student community, projecting the park as

TABLE 1 Seven talent cases (*cont.*)

	Ideon Meeting (ISP)	SPM Office (SPM)	Soft Landing (SPM)	CEVT HR (LSP)	LEAD Incubator (SPM)	Tech Pilots (SPM)	Shadow Board (SPM)
	Increase general business expertise among park management.	Define roles and develop models for efficient collaboration between SPM and key stakeholders such as the university and the municipality.				between firms when attracting talent. Suit the agenda of participant companies and project activities to each other. Incorporate the knowledge gained from Tech Pilots into tenant firm activities.	the best alternative for young individuals.

Outcomes	The meeting place welcomes nearly 10,000 people weekly. Start-ups and companies in the park are given opportunities to strengthen their networks and increase their access to know-how and financing.	The initiative has become important for those who wish to access the services provided by the park. The number of students and other academics visiting and taking part in park activities has been growing substantially, including female and international students Since SPM Office	Soft Landing helped SPM become an internationally well-known Science Park. About 10 companies – from India, the US, Germany, and Finland – have established themselves in the park and have brought with them skilled international professionals.	CEVT found that it was to their advantage to stay in Sweden in a long-term perspective. New, informal networks between Swedish universities and CEVT were established. Knowledge and technology transfer processes between CEVT	LEAD recruited about 10 CEOs, 100 board members, and 30 experts for its tenants.	The project has reinforced the image of SPM as being an exciting environment for young talent. Firms have strengthened their competitiveness and established valuable business and talent networks.	SPM has become much better known among university students. The board comprises eight student members from various disciplines and has a good balance between women and men.

TABLE 1 Seven talent cases (*cont.*)

Ideon Meeting (ISP)	SPM Office (SPM)	Soft Landing (SPM)	CEVT HR (LSP)	LEAD Incubator (SPM)	Tech Pilots (SPM)	Shadow Board (SPM)
	was launched 30 years ago, the park has grown substantially in number of tenants and employees.	Successively, over a 10-year period, the project became fully integrated into normal park operations.	and the Swedish transportation industry were established.		Participating companies have learned how to be more attractive to young professionals.	The meeting place “creActive” is a result of the work of the board. Contacts with students and access to mindsets of the younger generation have increased.

TABLE 2 Three Swedish Science Parks

Science Park / Characteristics	Ideon Science Park (ISP)	Lindholmen Science Park (LSP)	Science Park Mjärdevi (SPM)
Foundation year	1983	2000	1984
Localization	In Lund, in proximity to the Lund University.	In Gothenburg, closely located to the Chalmers University of Technology and University of Gothenburg.	In Linköping sited near Linköping University.
Main competences	ICT, connectivity, Life science, cleantech, medtech, smart material and food innovation.	Transport, ICT, and media industries.	ICT, visualisation, simulation, medical technology, mobile broadband, vehicle safety and security systems
Figures (2018)	400 firms and 9,000 employees.	350 firms and 11,000 employees.	370 firms and 7,000 employees.

Meeting, for example, organises events (see quote below) such as technical visits, conferences, workshops, business meetings, and skills forums.

> *Often the visiting groups are a small group of people with a clear purpose of their visit. That could be to collect information, meet the people or start-ups, get inspiration from the environment or the region. We often take them on site visits out of the house. We need to meet their needs by connecting them with the right people, decision-makers and politicians in the region. We only*

propose the program, but we never set the agenda. (*Ideon Meeting Operations Manager*)

The park management claims, however, that it is crucial to creating an understanding among stakeholders, that networking activities not only cost but also generate revenue, which in itself is a challenge.

To disseminate information about the park to potential talent recruits, SPM Office sends speakers to international conferences and applies for assistance from the embassies of target countries. The internet and social media also proved to be effective tools for connecting with foreign talent. As a result, park areas designed for meetings and events, such as creActive and Ideon Meeting, have, over the years, received an increasing number of visitors and have enabled park companies and start-ups to expand their networks and find new business opportunities and know-how. In this, they stress the importance of networking outside the Science Park, but also within the park context. A former CEO of SPM described the vital role that creActive plays in integrating students into the park,

SPM attracted more female and international students (*even didn't focus on internationals*) *than earlier. Moreover, SPM also had an increasing number of students visiting and "using" creActive and by doing that they also realized what SPM is all about.* (*Former CEO of SPM*)

4.2 *Supportive Activities*

Supportive activities, which aim to provide favourable conditions to attract talent, can occur at very early phases of the park's development, as the activities developed by SPM Office to recruit professionals to create an in-house support staff that offers find-and-recruit services, especially with an eye to increasing the internationalisation of park companies.

Our interviews show that support services are required when welcoming international companies and talent to help minimise barriers that may arise when businesses and individuals settle in the park. Such services make the park more attractive. Furthermore, the cases show that the studied parks frequently interact with the political system in order to bridge the obstacles encountered when international talent and companies come into the Park. They provided services to help integrate newcomers into Swedish system such as housing, immigration assistance, and other governmental formalities. Such activities were found in the Soft-landing and CEVT cases where they worked to integrate companies and professionals within the park so as to lay the groundwork for long-term relationships and collaborations between international talent and stakeholders – believed to be crucial for the future growth and development of the Science Parks.

The manager of the LEAD incubator pointed out that they use various business networks to find leaders and other strategic personnel for its tenants:

> *Our task is to support the development of the companies we work with, and to me, that also includes attracting and recruiting talents. LEAD has a vast network of contacts ranging from both formal and informal connections, and both private and public organisations.* (*CEO of LEAD*)

The incubator plans to establish a permanent function to manage the process of talent attraction. It will include setting-up external collaborations to more efficiently reach talented individuals headed to work with the incubator tenants within the Science Park.

Another talent attraction case is the Tech Pilots project that brings young talents to selected park tenants in order to develop new business solutions, and also teach firms how to become more attractive to young talent. Through interactive workshops and a project blog, an exchange of knowledge and experience, not only between young talents and firms but also between the participating firms, became possible. An additional outcome of this interaction was that talented individuals who participated in the project became ambassadors for the Science Parks. This in turn, led to strengthening the image of the parks and the establishment of valuable business and talent networks. The final project report expressed satisfaction with these efforts:

> *Some of the tech pilots knew about some of the companies before joining the program, but for many of them it became a "wow"-experience, realizing that there was so much cool technology in Mjärdevi and Linköping. Some of them stressed that Linköping is really good in system technology, combining different technologies and integrating them. For many of the pilots, this was their first contact with Linköping, and the first impression was very good.* (Mjärdevi 2016, p. 2)

4.3 *Integration Activities*

The interviews showed that university students, despite their proximity, do not easily become engaged in Science Park activities. As a result, the parks established initiatives to reach students. For example, a group of students was selected to work on the Shadow Board alongside the regular board members involved in the strategic development of the park. Through a Shadow Board, the park can access the aspiration, mindset and innovative ideas of a new generation of potential entrepreneurs and business leaders. The Science Park management indicated that through the Shadow Board they succeeded in attracting students from various disciplines and became better known in the university community. The ideas exchanged enabled the park to implement a portfolio of activities, such as "creActive", which became a popular meeting place for entrepreneurs and students. The student board members become park ambassadors to other students allowing for a dyadic flow of information between the student community and the park management. One of the park's CEO pointed out:

> *The dual flow of information between students and the SPM management is the most important contribution of the Shadow Board for SPM (Former CEO of SPM).*

Attracting talent and matching the recruited individuals with the real needs of the tenant firms is a perceived challenge for the parks. As well, management faces the problem of gaining the students' attention and reaching the student community with their message. The CEVT case showed one way of reaching potential talents at a university. Here the Science Park mediates between tenants and Swedish universities in order to attract both students and researchers to the park as well as to establish technology transfer links. The mediation carried out by the park was a deciding factor for CEVT's long-term business engagement in Sweden.

5 Results and Conclusions

Working to fill the gap in research on Science Parks, this study looked at methods for attracting talent for tenant firms and investigated the importance of such activities. In the cases analysed, we considered their objectives, activities, problems and results, independent of any specific park. We point to a number of challenges the parks face when organising collaborative networks to attract talent and meet the real needs of tenant firms concerning human resources.

Our study generated new insights into the portfolio of services provided by parks in order to develop talent attraction activities and attain Science Park success, such as the promotion of ties between university students and park tenants and the creation of an attractive environment for companies and talented individuals. Earlier research on mechanisms to stimulate the growth and development of entrepreneurs and their firms (including in Science Parks) stresses the importance of having a balance of "configuration" and "process" oriented resources in the supply of business support (Autio and Klofsten 1998; Albahari et al. 2018b). Many studies have shown that such process-oriented resources include many different activities related to business advice (Löfsten and Lindelöf 2002; Ferguson and Olofsson 2004), financing (Klofsten et al. 1999; Colombo and Delmastro 2002), and networking (Deeds et al. 2000; Phan et al. 2005; Leon 2008). The current study adds talent-attraction as a new theoretical element (c.f. Bellavista and Sanz 2009, p. 502) indispensable to understand the influence of human resources on the Science Parks development as well as the services they provided in order to promote the growth and development of their tenant firms.

On the activity level, our evidence shows that talent attraction in Science Parks can be implemented in many ways including (*i*) finding key personnel and management professionals for young and growing firms, (*ii*) creating platforms for attracting international firms and professionals, (*iii*) facilitating the exchange of knowledge and talent with higher education institutions, and (*iv*) conducting networking activities with student collectives. Often, the actors, such as the park management team, incubators, universities and tenant firms collaborate in an attempt to create a positive image of the park (Ferguson and Olofsson 2004). This positive image in turn, reaches talented individuals and facilitates joint projects connected to the park (Cadorin et al. 2017). Finally, we are aware of the large amount of research on human resources including on human and social capital, for example, the entrepreneurship research by Davidsson and Honig (2003) and by De Cleyn et al. (2015). Our study, however, does not aim to understand how the talent development process occurs. Rather, our aim is to contribute to the literature on Science Parks by concretely presenting and analysing the activities undertaken to attract talent to tenant firms.

6 Policy Implications and Future Research

Empirical studies on Science Parks have shown that they have a positive impact on tenants' performance (Siegel et al. 2003; Squicciarini 2008, 2009; Huang et al. 2012; Vásquez-Urriago et al. 2014). Nevertheless, authors seldom hypothesize about the mechanisms parks use to create value that results in higher performance for tenants. In this sense, our research has identified one of these mechanisms. If it is true that good talent management practices improve firms' performance, and parks perform effective talent-related activities, then we can conclude that such park activities are tools through which Science Parks can improve tenant performance. We should not forget that the recipients of talent-management practices performed by parks are tenants, i.e., the parks' source of income. Our findings provide justification for substantial public investments in Science Parks (Albahari et al. 2013).

Several of the activities we describe focus on supporting firms of different sizes and degrees of maturity. More than one study has observed the importance of designing support activities based on such criteria and we believe this to be imperative for Science Parks (Chordà 1996; Storey and Tether 1998). Talent attraction must address real ways to support tenant firms. In the case of start-ups, for example, it is essential to consider ways of protecting new firms from the "liability of newness" i.e, the high risk of failure in the first years of existence (Bergek and Norrman 2015). Because start-ups lack reputation and stable business relationships, they need time to gain market legitimacy. Therefore, in this scenario, Science Park talent management teams should understand the nature of start-ups and help recruit talent consistent with the needs of the new firm.

Science Parks form a critical mass that can be influential when talent in another region is deciding whether a move to a new region is to their benefit (Laur 2015). The attracting park must be able to offer exciting and challenging work, something more probable once it has reached a critical mass. This condition is essential if talent is to be attracted from world metropolises to smaller cities. Areas of competence, size of city, and scale of the park all affect critical mass.

Branding is another critical factor. Talent tends to look for reliable brands in their areas of knowledge and lifestyle (Papademetriou et al. 2008; Thunnissen et al. 2013; Chartered Institute of Personnel and Development 2017). These assets are particularly valuable when it comes to attracting "young, mobile, highly skilled and talented business groups." (Cannon 2008, p. 38). Therefore, the city, park, and tenant brands attract talent that has brand-related expertise. Thus, critical mass and the right brand are vital to the survival and growth of the park.

The shelf life of knowledge is limited. Ways of confirming and updating what is "known" are survival tools. One such tool is to attract university students and other representatives of tomorrow's talent (De Miranda et al. 2009). Students tend to be reasonably mobile, anxious to travel the world, and enthusiastic to seek challenges in employment (Bienkowska and Klofsten 2012; Frederiksen et al. 2016). Finding ways to network with student collectives should place near the top of any Science Park's priority list. Park tenants and talent attractors – with the world as their market – should use every opportunity to expand their networks internationally, to make new contacts, and to explore new entryways. The goal is internationalisation, which is now a requirement for those who want not only to survive, but to grow and drive Science Parks forward by attracting the best talent from a global pool.

The present study relies on seven cases at three Science Parks, and each case differs in focus. It is highly likely that more forms of talent attraction activities can be found at Science Parks. Future studies, with either a qualitative or quantitative approach, can target talent attraction activities by doing, for example, a comparative analysis of Science Park characteristics, structure, stakeholders and types of talent involved. There is the obvious future research question related to understanding the motivations and methods that Science Parks use to collaborate with stakeholders on talent issues. The challenge is to identify with greater precision the types of activities Science Parks undertake to attract talent. This study lays out a number of roads of inquiry on the future of Science Parks.

Abbreviations

CEO – chief executive officer
CEVT – China Euro Vehicle Technology AB
IASP – International Association of Science Parks and Areas of Innovation
ICT – Information and communication technology
ISP – Ideon Science Park
LEAD – LiU Entrepreneurship And Development
LiU – Linköping University
LSP – Lindholmen Science Park
R&D – Research and Development
SPM – Science Park Mjärdevi

Declarations

Availability of data and material

The datasets obtained and analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declared no potential conflicts of interest concerning the research, authorship, and publication of this article

Authors' contributions

EC and MK conceptualised the study, collected and analysed the data. EC, MK and HE wrote the first draft of the manuscript. AA contributed to the literature review and policy implications. AA and HE revised the manuscript and advanced the practical and theoretical contributions of the article. All authors read and approved the final manuscript.

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Appendix – Overview of the respondents

SPM	**Founding director and former CEO of SPM**	This respondent provided us with data and insights of SPM Office, Soft-landing and Shadow Board. We had five personal meetings, and a number of emails exchanged over 2016. The meetings were held at Linköping University.
	Current park CEO	This respondent validated the first four SPM cases and provided us with information about Tech Pilots project. We had three personal meetings, one at the IASP international conference in 2016.
	CEO of LEAD and deputy CEO of LEAD	Our first contact with LEAD in this project was during a presentation in which the CEO exposed the incubator's activities to attract qualified professionals for their start-ups. We arranged a lunch meeting to explain our research in more detail and took the opportunity to get the first insights into the talent attraction processes performed by LEAD. In addition, we had a telephone meeting in order to get more information about LEAD stakeholders, results and future challenges. A second phone meeting was held to get more detailed information on how LEAD use its networks, like regional partners, when attracting talent to its start-ups. Other questions and the validation of the case were made through exchanging emails.
LSP	**Current park CEO**	During the first Skype meeting with this respondent several talent activities were identified, but the Geely case (CEVT) seemed to be the most interesting at that time, for many reasons, such as the involvement of two quite different cultures (China and Sweden) and the relevance of the companies involved (Geely and Volvo). After this meeting, we exchange a few emails aiming to compose the case, and we had a last Skype meeting to confirm the data we have put in the table 1.

ISP	**Current park CEO**	In the first Skype meeting, we introduce ourselves, our study and the purpose of our contact, that is, we are interested in discovering a new talent case in the ISP. In common agreement, we chose Ideon Meeting because its potential in creating networking opportunities and new business possibilities as well as sharing knowledge and experience, thus providing a favourable environment for attracting new talent to the companies in the park.
	Operations Manager of Ideon Meeting.	This manager was indicated by the CEO of ISP and was responsible for providing us with detailed information about Ideon Meeting, as well as for the validation of the data we put in the table 1 regarding Ideon Meeting, pointing out any incorrect or inaccurate facts. Firstly, we had a phone meeting to briefly explain our study and how we plan to make a short case about Ideon Meeting. After a few emails exchanged, we had a Skype meeting to check the table and conclude the case.

3

Paper 3: Cadorin, E., Germain-Alamartine, E., Bienkowska, D., & Klofsten, M. (2019). Universities and Science Parks: Engagements and interactions in developing and attracting talent. In Developing Engaged and Entrepreneurial Universities (pp. 151–169). Singapore: Springer.

Universities and Science Parks: Engagements and Interactions in Developing and Attracting Talent

Eduardo Cadorin, Eloïse Germain-Alamartine, Dzamila Bienkowska and Magnus Klofsten

Abstract Many studies have shown that they have ceased to be mere facilitators of physical spaces to become important providers of services and resources to their tenants. Universities situated in or next to them play a key role in getting engaged in the development and the attraction of talent to Science Parks, to their tenant firms as well as to the region. Considering that skilled professionals are one of the resources that companies seek the most, Science Parks have dedicated numerous activities and means to become even more attractive to talented individuals, who can especially be found in entrepreneurial universities. In this study, we review the literature regarding the interactions existing between Science Parks or their tenants and their local universities. Talent attraction and entrepreneurship issues are addressed as the building blocks of these interactions. We strive to identify types of interactions that could differ in function of the maturity levels of the firms since their aims are not the same: at an early stage, firms tend to focus more on growth, whereas at a later stage, they tend to focus more on their development. We then point out policy implications, concerning both entrepreneurial or engaged universities and Science Parks.

Keywords Entrepreneurial university · Engaged university · University-industry collaboration · Science Park · Talent · Human capital

Introduction

Universities' ability to generate both knowledge and empowered individuals positively influences regional outcomes (Florida 1999; Gibb and Hannon 2006). In this sense, Charles (2006) highlights the important role of universities 'in the formation of human capital through the education of students as well as training activities for people already in work' (ibid, p. 119). Universities thus need to evolve along with their economic environments over time to not only survive but also better meet the

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needs of these environments. Etzkowitz (2003) states that the assignment of the university has been evolving, assuming a new role in economic and social development. Back in the 17th century, in their first years of existence, even star universities, such as Harvard, did not have a real economic impact, as the economy was based on the combination of physical labour and financial capital only (Audretsch 2014). Later, in the 19th century, the emergence of applied sciences seems to shift the role of universities: knowledge began to play a major role in the economy (Youtie and Shapira 2008). During the world wars, research results proved to be useful for the American army in particular (Audretsch 2014). From then on, some universities have become 'entrepreneurial' (Uyarra 2010, p. 1230). The research university seems to have been transformed to encompass the concept of entrepreneurship, changing into 'a teaching, research and economic development enterprise' (Etzkowitz 2003, p. 110). Processes of the entrepreneurial university lead to the creation of firms to bring research results into the market, to the transfer of technology, but also to the improvement of university's internal processes and structure (Kesting et al. 2014)—in short, to the use of spill-over mechanisms in order to diffuse their knowledge to their economic environment (Audretsch 2014).

In this context of evolving economic environments, Science Parks work as facilitators stimulating and supporting the growth of companies of all maturity levels (Rothaermel et al. 2007). Today's Science Parks are the result of transformations and evolutions of the first parks that began to operate in the second half of the 20th century in the United States (Colombo and Delmastro 2002; National Research Council 2009). US policy initiatives, such as the Bayh-Dole Act and the National Cooperative Research Act in the late 1970s and early 1980s, allowed universities and companies to form partnerships to market the results of university research (Link and Scott 2006). New US Parks have emerged in this scenario of university-industry collaboration and have become a model for other countries to develop their Science Parks (Westhead 1997). Regional development was the first driving force for the creation of Science Parks, fostering the revitalisation of local industries, mainly through the transfer of knowledge and technology from the university (Vásquez-Urriago et al. 2016).

The partnership with the university is relevant to Science Parks due to its ability to produce and distribute human capital (Mellander and Florida 2011), and to the influx of students (Etzkowitz and Klofsten 2005) and researchers with advanced ideas and skills (Cadorin et al. 2017). Considering the university as a 'provider of talent' (Florida 1999, p. 68), graduate students, alumni, researchers, and professors are all examples of talent in this study. Their knowledge and skills are the driving forces behind the growth of park companies as well as the development of new business in a Park. In this partnership, universities can be considered entrepreneurial, since the commercialisation of research is part of the regional economic development, and/or engaged, to the extent that they seem to get involved in the social development of their regions, for instance, through a role of 'workforce development' (Breznitz and Feldman 2012, p. 145). Moreover, because qualified people are a sought-after resource, Science Parks carry out different activities on their own or in collaboration with stakeholders to attract talent typically found in higher education institutions, such as universities.

University-industry interactions have been discussed extensively over the past few decades. Perkmann et al. (2013), for instance, review the literature on university-industry relations. They study 36 scientific articles published between 1989 and 2011 that deal mostly with knowledge transfer through the application of research. A focus is made on 'academic engagement' that occurs both in formal and informal ways (Perkmann et al. 2013, p. 1). However, in this large panel of references, Science Parks are mentioned only three times (Clarysse et al. 2005; Phan et al. 2005; Van Dierdonck et al. 1990), and neither talent nor attraction is ever introduced, as the teaching role of universities does not seem to be the focus of the literature review. Academic publications dealing with university—Science Park interactions for talent recruitment have been reviewed in this chapter. Research often seems to deal with both the issues of talent recruitment and of university—Science Park interactions separately (Florida 1999; Zhu and Tann 2005). It also seems to address talent attraction to the Science Park rather implicitly (Radosevic and Myrzakhmet 2009; Schiavone et al. 2014). The objective of this study is to study both issues of talent attraction and university—Science Park interactions in an explicit manner.

This study contributes to the research on entrepreneurial and engaged universities by addressing the role of universities in the economic and social development of their regions. It aims to identify the types of interactions and engagements occurring between Science Parks and their nearby universities, understanding and qualifying the university's role in developing and attracting talent that firms in Science Parks can recruit later on. In addition, this study also recognises and points out policy implications, concerning both entrepreneurial and engaged universities and Science Parks.

In particular, the following research questions are addressed: (i) What kinds of university—Science Park interactions aiming at attracting and developing talent are discussed in the literature? (ii) How do the formal and informal interactions between universities and Science Parks contribute to the attraction and development of talent for park firms related to their maturity levels?

Method and Data

The literature review aims to identify different types of interactions between universities and Science Parks regarding talent development and attraction to a Science Park, thus addressing our first research question. The analysis of the interactions found in the literature leads to the development of a theoretical model that suggests an answer to our second research question. Finally, some cases are highlighted that aim to illustrate how university—Science Park interactions may enable the attraction of talent into the Science Park.

We searched the databases Google Scholar, Scopus, and Web of Science by using a list of keywords (Table 1), as well as queries associating some of these different

Table 1 List of keywords used to search databases

Attract	Collaboration
Cooperation	Engagement
Entrepreneur	Incubator
Innovation	Interaction
Recruit	Research Park
Retain	Science Park
Skill	Talent
Technology park	Technopark
University	

keywords to specify our requests. In addition, we used references' lists of the selected papers to widen our collection of readings. We thus proceeded to an iterative process that comprised the following steps: (i) the collection of a set of articles; (ii) the adjustment of the collection with the rejection of some studies; (iii) the completion of the sample with the use of sources cited in the selected articles; (iv) a new adjustment of the sample with the rejection of some studies; (v) until the stage where the whole set of relevant cited sources in our sample had been explored. The search for new sources ended when the new references obtained by our interactive search process were either already in our set of articles or did not really contribute to the research. We initially determined that a minimum of 30 articles would be required, mainly covering the last 20 years of publication on the subject. A study was rejected from our collection if that study was not explicitly discussing—in the theory or through an example—at least one relationship that was (i) occurring between a university and a Science, Technology or Research Park; or (ii) dealing with human capital. This literature review is thus the result of the collection and the study of a final sample of 37 academic papers that explicitly discuss relationships between universities and Science Parks regarding the development or attraction of talent.

We chose to study some interactions occurring between Linköping University (LiU) and Science Park Mjärdevi (SPM) to illustrate our findings from our study of the literature. Three main reasons motivate the choice of these descriptive cases: (a) their relevance, since LiU has been characterised as 'entrepreneurial' (Svensson et al. 2012, p. 1) and the relationship between LiU and SPM focusses not only on the commercialisation of university knowledge but also on the attraction and development of talent (Cadorin et al. 2017); (b) the accessibility and the amount of data available, since SPM has had a close relationship with LiU for more than 30 years (Etzkowitz and Klofsten 2005); and both LiU and SPM share geographical, social and cognitive forms of proximity (Boschma 2005); (c) the possibility to illustrate a broad spectrum of activities and connections that can contribute to the engaged university.

In order to build the cases, we first conducted an in-depth study on the websites of both institutions to identify interactions that would potentially result in talent attraction. Once we had identified the areas involved on both sides, we scheduled meetings or sent questionnaires via email to the persons in charge of these areas. Semi-structured interviews were conducted with two representatives from Science Park Mjärdevi: the former CEO that was involved since the creation of the Science Park and had managed it for 30 years; and the current manager of community and employer branding. In addition, we met one of LiU Innovation Office's advisors, as well as one senior advisor of Demola. A follow-up interview was held with the SPM's Community and Employer Branding Manager to supplement the information collected during the first meeting, but also to obtain information about a new activity, and to test our theoretical model. In total, three questionnaires were sent by electronic mail, and four face-to-face interviews were conducted, that lasted between 30 min and 1 h each. In the end, we presented the written cases to each respondent to validate the information, and we brought the necessary adjustments according to the feedback received from them.

University—Science Park Interactions to Attract Talent: A Review of the Literature

In the literature, Science Parks are described in different ways, for example, research parks, technology parks or science and technology parks (Hommen et al. 2006). The inconsistency in definitions can express political or financial issues, which emphasise certain individual characteristics of each park. In the end, this lack of uniformity makes it difficult to apply the term consistently and broadly. Definitions from international associations, such as IASP (2017) and UKSPA (2017), point out that parks should stimulate and provide the required support for university-generated knowledge to flow appropriately to park companies in addition to offering high-quality business services and a prestigious location. Colombo and Delmastro (2002) and Westhead (1997) state that the establishment of connections with universities is an essential pillar for Science Parks to achieve their objectives. Moreover, Science Parks mainly aim to nurture the relationship between universities and industry (Minguillo et al. 2015), promoting proximity among them in several ways, such as in geographical, technological, and organisational ways (Vásquez-Urriago et al. 2016). The result is an environment that fosters innovation.

According to Audretsch, universities' roles are evolving to become 'broader and more fundamental—to provide thinking, leadership and activity to enhance entrepreneurship capital' (Audretsch 2014, p. 320), driven in large part by external expectations (Pavlin et al. 2016). In addition to research applications, a new focus is indeed made on 'creating entrepreneurial thinking, actions, institutions', collectively 'entrepreneurship capital' (Audretsch 2014, p. 319). This focus seems to be in line with the new 'engaged' mission of universities (Uyarra 2010, p. 1230), where knowledge sharing is dependent on social capital and relational involvement (Charles 2006; Clauss and Kesting 2017). Uyarra indeed defines engaged universities as 'enablers of regional development', that provide 'adaptive responses' to 'regional needs' through a 'contribution of higher education to social, cultural and environmental development' (Uyarra 2010, p. 1238). Gibb et al. (2013, p. 1) also state that the 'societal engagement' of universities is a way for them to behave entrepreneurially.

The recruitment of graduates from the university to Science Parks is frequently mentioned in the literature (Hommen et al. 2006; Löfsten and Lindelöf 2002; Vedovello 1997; Walcott 2002) and confirms the definition of the university as a 'provider of talent' by Florida (1999, p. 68). The recruitment of graduates of a nearby university can thus be considered as talent attraction. It, of course, can be made without the help of a university, once the training of the graduate is completed: the process can happen with exchanges occurring only between the graduate and the hiring company. However, the recruitment can also be a real interactive process between the Science Park and the student, through the implementation of internship programmes, for instance (Hommen et al. 2006; Huffman and Quigley 2002; Walcott 2002). This process enables the company to spot talent that could be worth attracting later on to develop the company and also enables the student to build skills during an internship by acquiring know-how. This practice is more and more frequent, all the more as some universities now demand a certain amount of time spent working for an organisation as a requirement for graduation. Another way for companies to detect talent is to get students involved in their projects (Vedovello 1997). In the framework of a course, for instance, the application of theory is made through a semester project that is physically conducted at least partially within the university by students, with professors as advisors, but for a client, that is the company that brought the project. Some tenant firms having spotted talent even proceed to grant scholarships in exchange for signing a contract of employment after graduation (Huffman and Quigley 2002).

Direct recruitment, job fairs to present the company on campus and conducting interviews are also often used to attract talent (Hommen et al. 2006; Huffman and Quigley 2002), as well as headhunting (Zhu and Tann 2005). Headhunting can be practised by several actors: the hiring firm in the Science Park, the Science Park management office, or a headhunting company, that could also potentially be a member of the Science Park. The formality of these interactions is justified by the signature of a written contract: internship agreements in the case of internships, signed by the student, the firm and the university; an agreement between the firm and the university to define the boundaries of the partnership and of the project for which students work for free in the framework of their training; an agreement for the job fair, in order to fix eventual fees and to clarify the support provided by the university (such as space or material); and headhunting can also imply an agreement between the headhunting organisation and the university or a part of the university (such as an alumni organisation) to exchange contacts or to publish advertisements. Firms having a higher level of maturity do these interactions with universities looking for talent to renew their business know-how (Klofsten and Jones-Evans 1996).

However, there are also interactions mentioned in the literature that deal with on-park firms with a lower level of business maturity, most of them being new companies emerging from universities or other park firms. Overall, Science Parks enable a conducive environment for innovation (Cadorin et al. 2017), engaging in different activities, such as organising events to create an arena where researchers can encounter innovators and entrepreneurs. In this sense, Science Parks bring industry and universities closer together, inspiring them to participate in regional economic development; they are one example of regional innovation systems (Coenen 2007). In such systems, universities spread their knowledge through education and training programmes (Klofsten and Jones-Evans 2013; Vedovello 1997). These programmes target students, providing them resources to become self-employed (Huffman and Quigley 2002), but they also focus on entrepreneurs from Science Parks, in the form of formal courses or more original forms, such as breakfast seminars (Klofsten and Jones-Evans 2013). But universities can go beyond their role of qualifying individuals through the commercialisation of their research results (Cai and Liu 2015; Coenen 2007), and they can behave entrepreneurially by relying on their incubators to support entrepreneurial students (Huffman and Quigley 2002), providing facilities (Walcott 2002; Westhead and Storey 1995) and services needed to operationalise their new firms (Cadorin et al. 2017). This kind of interaction represents a formal link between universities and Science Parks.

The lack of financial resources is a common problem in the initial stages of a firm that entrepreneurs need to overcome. To help them through this challenging period, universities and Science Parks work together by promoting competitions where students present their business plans to a panel of judges and the winners receive funding from participating companies (Huffman and Quigley 2002).

The geographic proximity is the most perceived way of Science Parks and universities interacting for talent attraction. It is informal to the extent that the university is seen as a prestigious scientific institution, thus conferring a positive image to companies of all levels of maturity that choose to be located in its surroundings (Felsenstein 1994; Mellander and Florida 2011; Quintas et al. 1992; Tan 2006; Vásquez-Urriago et al. 2016). The physical proximity within a cluster triggers the existence of informal information networks (Tan 2006). Strengthened by personal contact (Cadorin et al. 2017) through for instance an alumni network (Huffman and Quigley 2002), it can enable the flow of information concerning the need for or the availability of talent, but also the mobility of human resources for the creation of new firms (Dahlstrand 1997), or for the transmission of knowledge and skills (Tan 2006; Zhu and Tann 2005). Companies can also convey the needs of technology users and can guide university research according to market demands through these informal networks of information (Martínez-Cañas and Ruiz-Palomino 2010). Moreover, as universities internally support the entrepreneurship spirit of its students and researchers (Bienkowska et al. 2016; Díez-Vial and Montoro-Sánchez 2016; Etzkowitz and Klofsten 2005; Klofsten and Jones-Evans 2013; Klofsten and Lundmark 2016; Martínez-Cañas and Ruiz-Palomino 2010), the physical proximity enables entrepreneurs from universities to use the facilities of Science Parks informally (Cadorin et al. 2017).

Talented individuals are known to be attracted to 'progressive environments' (Florida 1999, p. 71), with a high quality of life, infrastructures, employers, and other talent, which is what Science Parks seem to embody. In general, Science Parks do not need formal contracts with the university to create such environments, even though the involvement of the university in the park ownership or management certainly implies one, making it a formal interaction (Albahari et al. 2013). However, the image of the Science Park and its brand (Cadorin et al. 2017) are crucial to attracting talent, and the informal interaction between the Science Park and the university lies in their mutual enhancement of image, through individual initiatives—for instance, academic publication of quality for the university—but also joined initiatives, such as research partnerships or co-organisation of events. Moreover, the interactions can be made directly by the Science Park management office (Löfsten and Lindelöf 2002; Martínez-Cañas and Ruiz-Palomino 2010; Phillimore 1999; Vedovello 1997), without implying the writing and signature of agreements each time.

The use of the Internet (social media, newsletters) by the Science Park, its tenant companies (Cadorin et al. 2017), the university, but also by mixed organisations owned by both the university and the Science Park are also informal interactions to be noted; they are useful in sharing needs for skills and particular profiles as well as events, successes, and a positive image of the environment; in other terms, to attract talent to the Science Park. Thus, the importance of social networks should not be underestimated; not only the virtual but also real ones, such as alumni networks (Huffman and Quigley 2002; Walcott 2002) that are precious resources to search for talent for the Science Park and the region, especially from their nearby university. Apart from alumni, the staff of the university can also use its network to observe the labour market of the Science Park. A case is described by Huffman and Quigley (2002, p. 407): 'a staff member of Berkeley's Haas School of Business Recruiting Office spends one day a week in Silicon Valley, marketing the business school directly to selected firms and collecting information on Silicon Valley hiring trends'.

Informal interactions between universities and Science Parks seem to occur more spontaneously and more easily to implement to the extent that formal agreements are costly (in time, money and human resources) to set up.

Informal and Formal Interactions to Attract Talent Depending on the Firm Maturity Level

The interactions collected from our literature review seem to be characterised by two dimensions: a degree of formalism and the alignment with a strategic aim, according to the maturity level of a firm or a new venture idea involved in the interaction. In this section, we present a model built on our collection of interactions collected in the literature given above. Our model (Table 3) displays common aims for the interactions sharing the same dimensions, which are in fact intermediary objectives of the interactions towards the attraction of talent in the Science Park.

The model proposed in this study is based on the motivations of the engaged university to interact with the Science Park or its tenants and vice versa in talent issues. The literature suggests that the university acts as a 'provider of talent, knowledge, and innovation' (Florida 1999, p. 68), and it feeds the region with a steady flow of talent (Etzkowitz and Klofsten 2005). This process occurs first in the attraction of renowned scientists and engineers, who in turn attract talented students who are potential inventors and entrepreneurs as well as future skilled labour for park companies (Florida 1999), suggesting that the university plays both an entrepreneurial role by taking part in the local economic development and an engaged role by being involved in the social development of its region.

On the one hand, entrepreneurial universities and Science Parks interact both to assist the creation of new knowledge-intensive enterprises (Klofsten and Lundmark 2016) as well as to support the business growth of the park's tenant companies (Klofsten and Jones-Evans 2013). In this way, the purpose of the interactions and the way in which they occur are directly dependent on the maturity level of the companies involved, as well as the entrepreneurial behaviour of the university; and the attraction of talent to the park's companies is one of the desired results.

The level of maturity of companies varies within a spectrum that has its beginning in small firms in their initial phase of establishment, traversing to the companies that already have experienced management teams and well-established development programmes (Klofsten and Jones-Evans 2013).

University students and researchers, or even corporate employees, are potential entrepreneurs who can create new ventures, leading them through the early stages of the enterprise development. In order to adequately support new entrepreneurs, the universities can offer (i) training courses and programs to develop entrepreneurship; (ii) consulting with business advisors; and (iii) incubator facilities and services (Harper and Georghiou 2005; Klofsten and Lundmark 2016)—making it itself entrepreneurial. Interactions of the entrepreneurial university with well-established companies in the park occur, among other forms, through technology transfers, consultancies of specialised university personnel, or training of company employees or hiring researchers or graduate students by the companies involved (Harper and Georghiou 2005).

On the other hand, the existence of formal and informal links between university and industry was first mentioned in 1981 by the OECD, and for example, Löfsten and Lindelöf (2002) used this terminology in their research. However, our literature review has a much narrower focus, as it deals with Science Park-university interactions in order to attract talent for the Science Park. As we have been reviewing the literature concerning interactions between Science Parks or their tenants and their nearby universities, we have been guided by the proposition of a taxonomy of links that can occur between on park firms and the universities as proposed by Vedovello (1997). In this taxonomy, three categories of links are defined: formal links, informal links and human resources links. '[…] formal links […] presuppose the establishment of formal contracts between the partners, with both the commitment and the payment of fees previously established' (Vedovello 1997, p. 494). Informal links and human resources links do not require formal contracts. What differentiates these two categories is that 'human resources links' deal specifically with informal individual relations whereas 'informal links' concern material and knowledge exchanges. This taxonomy was found relevant and used by other authors, such as Phillimore (1999) for his study on the Western Australian Technology Park, and Bakouros, Mardas, and Varsakelis (2002) study of Greek Science Parks. We also chose to use this categorisation; however, we chose not to keep the ‘human resources links’ (Vedovello 1997, p. 494). In our case, the attraction of talent for the Science Park is the aim of the interactions, so human resources issues should be considered as aims rather than as interactions. Thus, we define:

- Formal interactions as interactions implying a written agreement or contract between the Science Park or its tenants and the engaged university that can but does not necessarily involve a money transaction;
- Informal interactions as all the other interactions that are not determined by the establishment of a formal contract between the Science Park or its tenants and the engaged university.

Defining those two descriptive dimensions of the interactions collected in the literature, as showed in Table 2, enabled us to create our classification of interactions, all aiming at attracting and developing talent for the Science Park.

We observe that within each category, the interactions tend towards a common objective that is a step towards their ultimate goal of attracting talent for the Science Park. Indeed, we observe that:

- for firms or new venture ideas with a lower level of business maturity:
  - formal interactions tend to support talent creating their own businesses, resulting in the integration of talent in the Science Park;
  - informal interactions tend to create meeting places so that talent can find inspiration and resources to settle their business in the Science Park;
- for firms with a higher level of business maturity:
  - formal interactions tend to support businesses in spotting talent in the university, to be able to attract them after graduation;
  - informal interactions tend to create an attractive environment where businesses can spread their need for skills and meet talent.

The categorisation proposed in this paper based on two dimensions, i.e. degree of formality and degree of maturity, is summarised in Table 3 and further explored through the use of illustrative cases in the next section.

Illustrative Cases of Interactions

In the following section, we present six cases that describe university—Science Park interactions related to talent attraction. The cases are coherent with our model (Table 4):

Table 2 Interactions collected in the literature

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Organise or participate in education and training programmes (Klofsten and Jones-Evans 2013; Vedovello 1997)	Recruitment of graduates (Hommen et al. 2006; Löfsten and Lindelöf 2002; Vedovello 1997; Walcott 2002)
		Provision of resources to help students become self-employed (Huffman and Quigley 2002)	Internship programmes (Hommen et al. 2006; Huffman and Quigley 2002; Walcott 2002)
		Commercialisation of knowledge (Cai and Liu 2015)	Scholarships in anticipation of employment after graduation (Huffman and Quigley 2002)
		Business plan competitions (Huffman and Quigley 2002)	Job fairs on the university campus (Hommen et al. 2006; Huffman and Quigley 2002)
		Breakfast meetings and seminars accessible through membership to entrepreneur club (Klofsten and Jones-Evans 2013)	Researchers and students' involvement in projects (Vedovello 1997)
		Use of university's facilities (Walcott 2002; Westhead and Storey 1995)	Engagement of university academic staff for consultancy (Vedovello 1997)
		Incubators (Huffman and Quigley 2002)	Involvement of universities in park ownership/management (Albahari et al. 2013)
		Regional innovation systems (Coenen 2007)	Headhunting (Zhu and Tann 2005)
	Informal	Support for academic entrepreneurship (Bienkowska et al. 2016; Díez-Vial and Montoro-Sánchez 2016; Etzkowitz and Klofsten 2005; Klofsten and Jones-Evans 2013; Klofsten and Lundmark 2016; Martínez-Cañas and Ruiz-Palomino 2010)	Marketing the business school to previously chosen companies and obtaining information regarding hiring trends (Huffman and Quigley 2002)

(continued)

Table 2 (continued)

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
		Human resources flow, mobility resulting in the creation of new firms (Dahlstrand 1997)	Human resources flow, mobility resulting in the flow of knowledge and skills (Tan 2006; Zhu and Tann 2005)
		Students using Science Park's facilities (Cadorin et al. 2017)	Science Park brand/image (Cadorin et al. 2017)
		Personal contact (Cadorin et al. 2017)	Use of internet (newsletters and social media) (Cadorin et al. 2017)
		Physical proximity to the university. A location that confers status and prestige (Felsenstein 1994; Florida 1999; Quintas et al. 1992; Tan 2006; Vásquez-Urriago et al. 2016)	
		Informal information networks (Tan 2006)	
		Alumni network (Huffman and Quigley 2002)	Alumni network (Huffman and Quigley 2002; Walcott 2002)
			Fostering links between the university and park tenants (Löfsten and Lindelöf 2002; Martínez-Cañas and Ruiz-Palomino 2010; Phillimore 1999; Vedovello 1997)

Table 3 University—Science Park interactions to develop and attract talent

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Support talent in the development of new ideas and creation of new firms	Support firms in spotting talent in the university, and create opportunities for temporary involvement
	Informal	Create meeting places so that talent can find inspiration and resources	Create an environment where firms can express their needs for skills

LARM

SPM and student organisations of Linköping University interact informally to promote recruitment fairs together annually, creating opportunities for companies, regardless of their maturity level, and students to get to know each other. In such interactions, Linköping University has a slight participation or even none. This practice is justified in the words of the SPM Community and Employer Branding Manager:

Table 4 Illustrative cases from Science Park Mjärdevi

		Interactions with Science Park tenants having a:	
		Lower maturity	Higher maturity
Formalism of interactions	Formal	Demola	
		LiU game awards	LARM
		LiU innovation	Sommarmatchen
	Informal	LEAD incubator	Östgötamorgon

> […] for matters regarding talent attraction, I have more interactions with student unions than with LiU as an organisation, because this is a more direct and faster collaboration.

SPM invites companies, but the contract and payment of the fee are carried out directly with the student union Lintek. Approximately 200 students and 35 companies participated in the 2017 edition.

LiU Innovation

LIU Innovation is owned by Linköping University with the mission to support academic entrepreneurship. Its primary aim is interacting informally with students and researchers to mature their business idea and prepare them with all necessary skills. In the end, the team should be self-sufficient and able to properly conduct their venture to grow into a valuable business in the next stage, that is for some ventures joining the incubator, LEAD. Although Linköping University owns LiU Innovation and is one owner of LEAD, they are housed in Science Park Mjärdevi facilities, immersed in its business environment and somewhat out of the academic context, representing a smooth integration of the academic and business environment and vice versa.

Sommarmatchen

Sommarmatchen is a 6-week programme promoted by LiU Innovation, where a group of university students have the opportunity to formally participate and get involved in projects of prospective or newly formed research-based companies of Linköping University researchers. Temporary hiring during summer holidays allows companies to test the students, who are required to take academic ideas to a different perspective, such as a market analysis.

The links generated by the programme are the basis for the future recruitment of students, allowing them to stay in the region after graduating. This opportunity generation is one of the leading concerns of Linköping University, according to an innovation adviser at the LiU Innovation office, who states:

> […] make students stay and start their careers in this region is the challenge of the university, Mjärdevi and the Östergötland region.

LiU Game Awards

Linköping University annually develops a competition among entrepreneurial students called ‘LiU Game Awards’. Science Park Mjärdevi formally participates as an event sponsor. In the competition, students present the games that they have developed, which are evaluated by experts from the gaming industry, and the best games are awarded. These events aim to support students with new ideas and business in their early stages.

Demola

Placing students and companies in contact is a means of building the students’ entrepreneurial skills and facilitating attraction as they both have the opportunity to recognise the qualities of the other. Considering this, Linköping University offers an entrepreneurship course for interdisciplinary development in cooperation with the international development platform Demola. In this course, students can broaden their networks and also develop their professional skills. The projects are created based on real problems of the companies and students work in teams to offer a solution. The course promotes the integration of companies with students, who are able to demonstrate their qualities, which links to future recruitment. In addition, by working with other students and developing new solutions, there is also the creation of links between students, who may in the future develop a new venture together. Both situations contribute to the recruitment of young university talent.

Östgötamorgon

The purpose of attracting’ talent is not limited to current students but extends to Linköping University alumni network. Former students are also desired. In order to attract former students back to the region, the County of Östergötland organises an event called ‘Östgötamorgon’ in collaboration with Linköping University, which is in charge of sending invitations to its alumni, Science Park Mjärdevi and twelve municipalities in the region of Eastern Sweden. The event consists of meeting around three times each semester in Stockholm for networking and attending lectures during breakfast. The goal is to strengthen ties with former university students and bring them back to the region as they potentially have extensive business experience and can add value to both small and large park companies.

Conclusions and Implications

The reviewed literature as well as the illustrative cases suggest that universities have been playing their role 'in economic and social development' (Etzkowitz 2003, p. 110), assuming a mission 'in developing pedagogies and practices that stimulate entrepreneurial attributes and values, provide real insights into the entrepreneurial life-world' (Gibb and Hannon 2006, p. 90). By acting entrepreneurially, the university prepares and supports its students and researchers, as well as the workers of the Science Park, in all aspects involving entrepreneurship. This seems facilitated by the existence of a structure and diverse services provided in the associated Science Park—whether by the Science Park office itself or by the university. This engagement of universities in their social and economic environments, however, does not only benefit the emergence of new businesses, but also in-park consolidated companies, for instance. They might also gain the opportunity to interact with university students during their studies or even after graduation, allowing them to select the best professionals for them, in terms of qualifications and alignment with the company profile.

One of our main aims was to search the literature for theory regarding the interactions occurring between engaged universities and Science Parks to attract talent for on-park firms. While looking for an answer to our first research question, we noticed that some interactions are mentioned, but in most cases, university—Science Park relations and talent recruitment are treated separately in academic literature. Our literature review has highlighted the fact that these interactions can be characterised by two dimensions in particular: the degree of formality (Vedovello 1997); and the degree of maturity of the involved firm (Klofsten and Jones-Evans 2013). Our literature review has also raised questions regarding the stakeholders involved in the interactions: even though we have been focussing on interactions between the engaged university and the Science Park, both organisations gather multiple stakeholders: for instance, interactions can occur between the Science Park management office, or tenant firms, and between the university administration, or organisations belonging to the university, or even student organisations.

Furthermore, we have studied more in depth how the formal and informal interactions contribute to the attraction of talent, for firms with different levels of business maturity. Our classification of interactions has led us to distinguish four main types, thus answering our second research question: (i) creating meeting places, where firms can diffuse their need for specific skills and (ii) meeting talent (Huffman and Quigley 2002; Tan 2006), and (iii) where talent can find an attractive environment to start a new business (Cadorin et al. 2017; Díez-Vial and Montoro-Sánchez 2016); (iv) spotting talent (Hommen et al. 2006; Walcott 2002); and (iv) supporting talent in their creation of new companies (Huffman and Quigley 2002; Westhead and Storey 1995). Beyond classifying the interactions collected from the literature, this theoretical model shows intermediary objectives that are used together by Science Parks and their nearby engaged universities to facilitate talent attraction.

Observing the interactions occurring between Linköping University and Science Park Mjärdevi for talent attraction enabled us to verify that these interactions illustrate what we have found in the literature. For example, firms with a higher level of maturity tend to create formal links with the university in order to renew their staff by recruiting graduates. Recruitment fairs and participation of university students in firm's projects seem to be efficient recruitment tools. On the other hand, new ventures or firms with a lower level of maturity take advantage of the formal links with the university to get a qualified support to develop their business. In this case, the university needs to be entrepreneurial and engaged in developing the entrepreneurship skills of its students by providing training programmes or helping them to develop their ideas by offering consulting services at innovation offices and incubators. The informal links occur mainly considering the geographical proximity of firms and universities as well as their participation in events. Young and senior talents can be reached in such events and recruited to companies either with high or low maturity levels.

A number of policy implications arise from this study for engaged universities, Science Parks and their tenant firms. Firstly, university managers might stimulate the entrepreneurial spirit of students and researchers, giving them the opportunity to network, develop their skills, and mature their ideas. Entrepreneurship courses that integrate students and researchers in firm projects, seminars and network events are examples of activities that can contribute to the qualification of the young entrepreneurs so that they are prepared to enter the incubator and later in the Science Park, retaining talent in the region.

Secondly, Science Park managers might be alert to the needs of their tenants and create opportunities for companies and talent to meet and get to know each other. The matching of interests will occur naturally when the environment is open to networking and interactions. Providing such environment should be one of the main objectives of the managers in order to attract university talent.

Finally, tenant firms need to understand that in order to attract university talent, they must increase their participation in academic activities, seeking to interact with students and researchers, so that they have the opportunity to get to know companies and their projects better. The participation of the company in academic courses besides contributing to the entrepreneurial training of the students also creates interpersonal and professional bonds that will influence a future recruitment cycle. In order to influence students positively when they are seeking employment, company managers should plan activities to advertise the brand and the company's areas of expertise, in addition to its needs for talent with certain skills. In addition, small actions, such as integrating students and researchers into their networks, creating links and encouraging the discovery of common interests among academics and entrepreneurs, can also contribute to attracting academic talent.

Future research could explore to what extent tenant firms can influence the content of the teaching offer of the engaged university. It could also investigate to what extent the university influences the choices of its nearby firms to orientate their activities towards an area covered by the university, both in terms of research and education. Such studies could develop policy implications for universities to closer adapt their curriculum to the needs of the society, benefiting themselves, as well as the workforce, businesses, and also the economy as such.

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Science Parks, talent attraction and stakeholder involvement: an international study

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Abstract
One aspect of Science Parks development that has come into focus is the attraction of talent, which could include attracting specific expertise, making it easier for firms to be established and reach skilled workers. In order to encompass different contexts, both economic and cultural, a questionnaire was sent to 120 Science Parks, of which 59 (49%) replied. The study included 22 variables, including eleven independent variables according to Science Park stakeholders and characteristics when selecting talent for tenant firms, five control variables, and six variables of Science Park success dimensions. The results show that the characteristics of talent contribute to the park's success. Universities are the primary source of talent, and the government has a critical role in promoting collaboration between firms and universities. Therefore, park managers should promote links with local universities and the student community as well as strengthen their relationship with government representatives at all levels to receive the necessary support for park development.

Keywords Science Parks · Talent attraction · Technology-based firms · Success factors · Policy

JEL Classification M13 · O32 · O44 · R11 · R58

1 Introduction

As policy instruments, Science Parks have in recent decades come to occupy a special niche. Their role, to encourage innovative start-ups and regional clusters, has expanded as new needs in global economies have arisen or become compounded in the currently

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developing low-growth, or lower-growth, era. Link and Link (2003) underline that during a long period, the term “Science Park” has evolved to become a generic term. The primary concern of Science Parks is to incubate, often from the start, knowledge-based businesses with the potential for rapid growth and socially beneficial innovative solutions. This incubator environment has, in turn, attracted international businesses desiring to access specific knowledge and participate in its development, to the mutual benefit of both the business and the park. The formal and operational links of the Science Parks with stakeholders in knowledge creation, such as research entities and universities and higher education institutes, have ensured outside attraction.

In recent years, one aspect of Science Park development has run into some obstacles: how to attract and develop the talent needed to satisfy the growing needs of park tenants. One of the factors underpinning the success of every organisation is the ability to find and then retain employees with relevant skills (Osburg et al. 2018). Studies of technology-based firms in high-technology sectors have observed substantial shortages of competent workers, which in turn undermines business growth and profitability (Sayer and Morgan 2018). Because most firms in Science Parks are technology-based and strongly dependent on access to qualified workers, researchers are beginning to focus on issues linked to the Science Parks that affect their ability to attract and develop customised talent solutions for their tenants (Bellavista and Sanz 2009; Bonacina Roldan et al. 2018; Chen and Yu 2008).

Regionally, the dominant knowledge base is a strong factor in creating a social and business climate that appeals to talent (Asheim and Hansen 2009). Silicon Valley, Singapore, Taiwan and Cambridge are examples where nearness to world-class universities was an almost irresistible appeal for technology start-ups. In each instance, however, access to talent was the determining factor in new technology and product innovation for the global market. Hu (2008) found a positive correlation between performance levels of Science Park tenants and the informal relationships and mobility of high-tech talent. This correlation not only occurred with park proximity to regional high-tech knowledge and industrial clustering but also arose as a result of Science Park activities that facilitated personal meetings, informal communication channels, professional networks, and spin-offs of human resources, among others.

Cadorin et al. (2017) demonstrate in a number of case studies of Swedish Science Parks that have independently or in collaboration with stakeholders developed many concrete tools for attracting talent: shadow boards which allow university students to participate in Science Park management, soft landing for attracting foreign firms, and the LEAD Incubator which recruits expertise and management personnel for start-ups. However, the research seldom addresses such issues. A major advantage of Science Parks is they offer services that firms internally find difficult to provide in collaboration with other stakeholders; network with the departments of other educational and research entities; assist in the subsequent exchange of knowledge; build strategic alliances; attract talent; and discover partners in contracts and agreements. Such offerings facilitate the development of specialised products or services at a lower cost than would otherwise be possible.

Despite the popularity of Science Parks among researchers and the big interest in promoting entrepreneurship and regional development, very few papers have focussed on Science Park development the attraction of talent and the collaborations that occur regarding the talent attraction processes (Bellavista and Sanz 2009; Bonacina Roldan et al. 2018). To our minds, the scarce knowledge in an area that has become of major import points to a clear knowledge gap. Thus, the overall aim of this paper is to investigate how collaborations between Science Parks and their stakeholders attract talent. Of particular interest are (1) how does stakeholder collaboration affect Science Park success in the attraction of talent? And (2) how do talent characteristics affect Science Park success?

The present study investigates Science Parks to expand our understanding of talent—human resource management—in the fields of innovation. We analysed 59 Science Parks in 2018, which should be seen as a relatively decent sample of Science Parks considering a recently published study (cf. Ng et al. 2019) where the sample consisted of 82 parks, making it one of the larger studies using Science Parks as a unit of analysis. All surveyed parks were full members of the International Association of Science Parks and Areas of Innovation (IASP), and total employment (among firms and park management) was 217,055 persons. The present study contributes to the literature on Science Parks, talent attraction and park stakeholder relationships as well as addresses policy issues on park management. Following the introduction is a discussion of the literature (Sect. 2), a description of the empirical setting (Sect. 3), and a presentation of the empirical evidence with a discussion of the empirical results (Sects. 4, 5). Then the conclusions and the policy implications and further research resulting from this study are consolidated in Sects. 6 and 7, respectively.

2 Literature review

In the last 30 years, hundreds of Science Parks of various sizes and orientation have been established around the world. These parks have launched numerous strategic collaborations with other Science Parks and organisations nationally and internationally in order to access the resources necessary to meet the needs of their tenants successfully. Though policymakers believe strongly that Science Parks are a powerful force that contribute to the regional economic ecosystem (Lecluyse et al. 2019), many researchers have questioned whether the evidence is sufficient to support the benefits attributed to parks (Gwebu et al. 2018; Macdonald 1987). Earlier studies report no positive evidence, particularly concerning attributes, such as growth in a number of regional jobs, start-ups and venture capital operations (Vásquez-Urriago et al. 2014). Other studies maintain that Science Parks have historically focussed on delivering configurational resources, such as office space, production areas and strategic locations, near a university (Autio and Klofsten 1998, p. 33). In addition, previous deficiencies included a lack of resources for the day-to-day management and limited offerings of soft activities in various areas, such as business development counselling, coaching and network activities. In their studies of English Science Parks, Massey et al. (2003) add that the single-minded design and construction of parks that focusses on attracting only highly educated talent contributes to social polarisation.

Recently, however, the strategies, activity portfolios, and integration with the regional economy have undergone radical changes and have become more professional. Most Science Parks now have more resources, which have allowed a broader offering of business support services, matchmaking events, hackathons, meeting places and social and cultural activities. The stakeholder philosophy of park management has evolved over the years toward greater collaboration with park tenants in order to discover real development needs, and with actors in the entrepreneurial ecosystem who can offer the Science Parks resources critical for reaching strategic goals (Bellavista and Sanz 2009; Phan et al. 2005, Albahari et al. 2019).

2.1 Science Parks and talent attraction

Science Parks have been pushed to rise above the perception that they are simply a collection of office spaces and show that they are active supporters and mentors of firms at all levels of maturity (Rothaermel et al. 2007). Talent needs differ according to firm maturity (Phan et al. 2005). Mature firms aim to improve existing production processes through contact with innovative ideas and the hiring of young mindsets, which university students usually possess (Klofsten and Jones-Evans 1996). Younger firms, however, often lack managerial or technical competence in their team (Bøllingtoft and Ulhøi 2005), and so they are more dependent on Science Park support to find professionals with specific skills, such as managers or a CEO (Zhu and Tann 2005), than mature firms. Wetter and Wennberg (2009) highlight that start-ups, which build a team of qualified people early on, are more likely to survive.

Some studies (Colombo and Delmastro 2002; Westhead 1997) have observed that Science Parks should consider the establishment of connections with universities as a priority in order to more easily access skilled human capital, such as students with innovative ideas and academics with advanced knowledge (Mellander and Florida 2011). University student recruitment to tenant firms is often cited in Science Park literature (Hommen et al. 2006; Löfsten and Lindelöf 2002; Walcott 2002), and it can occur in a variety of ways, for instance, involving young talent in the business activities of tenant firms (Vedovello 1997). Establishing a triple-helix configuration fulfils the conditions required to achieve Science Park objectives, and links with the local university and with government actors are essential. Networking with government authorities allows the park to offer effective policy support for their tenants and creates a stable environment for the recruitment and development of skilled workers (Etzkowitz and Zhou 2018).

Science Parks foster informal interactions between their stakeholders in a number of ways, for instance, by creating informal information networks (Tan 2006), providing easier access to local university research facilities and their results (Albahari et al. 2018), connecting with alumni networks (Walcott 2002), communicating the activities the local universities develop and announcing employment opportunities in tenant firms (Huffman and Quigley 2002). Soft factors, such as a prestigious address (Storey and Westhead 1994) and branding (Salvador 2011), also contribute to making the environment favourable for attracting talent (Cadorin et al. 2017).

2.2 Talent characteristics

The technological evolution, which has produced faster and more efficient dissemination of information, has reduced the influence of physical and organisational capital resources on firm competitiveness. Human capital has become an essential factor in determining the performance and success of firms (Schiavone et al. 2014). Indeed, maintaining the competitive advantage of a firm relies primarily on its human resources and their capacity to innovate; such resources usually have a high concentration in a Science Park (Cheba and Hołub-Iwan 2014; Ferguson and Olofsson 2004; Holland et al. 2007; Siegel et al. 1993). Talent management has become critical to business survival, and managers now strive to understand better the nature of talent and who can be considered an appropriate talent for their firms (Cappelli 2008; Thunnissen et al. 2013).

At first view, talent comprises persons with specific experience and abilities (Gagné 2004; Saddozai et al. 2017), but it is not enough to define talent just as a gifted person. Talents also have the motivation and drive to perform at a higher level than their peers and provide knowledge and skills to the firm. They are interested in developing a corporate culture, social networks and organisational structure, which are difficult elements for competitors to copy (Barney 1995). Thus, the skills of talent include potential, performance, creativity, competence, and leadership abilities (Saddozai et al. 2017). Also, they commit to applying such skills in order to achieve exceptional results (Gagné 1985; Gallardo-Gallardo et al. 2013; Saddozai et al. 2017; Tansley 2011). High performers or people with high potential can only be considered talented if they also have exceptional abilities (Thunnissen and Van Arensbergen 2015). For this reason, students, junior researchers, and professionals endeavour to raise their qualifications to become more attractive for firms (Papademetriou et al. 2008).

Several studies (Gallardo-Gallardo et al. 2013; Saddozai et al. 2017; Tansley 2011; Tansley and Kirk 2017; Thunnissen and Van Arensbergen 2015) consider different contexts in their analysis and report the main characteristics and dimensions of talent as science and technology expertise, business experience, personal skills, leadership, social skills and behavioural aspects. However, environmental factors, for example, the working conditions, opportunities and working relationships, can affect how well talents achieve results, so merely using past success as the only parameter does not guarantee future performance (Thunnissen and Van Arensbergen 2015). Thus, the working conditions and opportunities contribute to talents performing their best (Thunnissen et al. 2013).

2.3 Science Park performance: success dimensions

Different parks have different characteristics (see Albahari et al. 2018; Liberati et al. 2016) and interact with a diverse set of stakeholders (see Albahari et al. 2017) and therefore, may have different objectives. Therefore, the understanding of what is success or failure may differ between them. IASP was created in 1984 and today has 345 members around the world; more than 115,000 firms are localised in the parks in 77 countries. IASP defines a Science Park[1] as 'an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions'.[2] Considering the IASP definition of Science Parks, the primary motivations for the existence of a park would be the benefits offered to tenant companies and the local community (Guadix et al. 2016). Therefore, provide these benefits can be considered the fundamental objectives of every park.

In addition, Rowe (2014) lists the most common Science Park efficiency indicators: the park area and its built area; the number of tenant firms and their number of employees; the number and size (number of employees) of firms spun off from the park; the types of jobs that the activities of the park generate as well as the number of skilled workers, for example, scientists and engineers; rent and services the park provides; the type and variety of general and professional services offered by the park; funding for capital and operational purposes; and investment projects attracted to the region by the park itself or in cooperation with other regional actors. Several researchers have analysed firm performance in incubators/Science Parks as survival/closure rates (Löfsten 2016), economic outcomes (employment growth, sales growth, profitability: Löfsten and Lindelöf 2001, 2002; Monck et al. 1998), technological level and also links to higher education institutions (Lindelöf and Löfsten 2004; Macdonald 1987; Massey et al. 2003; Quintas et al. 1992).

[1] https://www.iasp.ws/our-industry/definitions.

[2] IASP has three membership options: full member, affiliate and associate. The first considers Science Parks in operation; the second Science Parks under construction and the third is for those that are not Science Parks (associations or even individuals).

Hogan (1996) suggests grouping success dimensions of Science Parks into two categories: (1) intrinsic, those related to the attainment of technological synergy, and (2) extrinsic, related to economic development. Other dimensions, such as years of operation, R&D expenditures, the incomes and the innovation outcomes of the tenant firms, and linkages with local universities and research centres, add up to generate a comprehensive list of Science Park success dimensions (Albahari et al. 2013; Guadix et al. 2016; Lee and Yang 2000). Furthermore, the network of partners has a significant impact on park success, and the role and commitment of its stakeholders are often considered essential dimensions in park evaluation (Bigliardi et al. 2006; Guy 1996).

Finally, in addition to the influence of the regional economy, several other internal dimensions may inhibit the park from achieving the desired results; these dimensions include the absence of an entrepreneurial culture, unavailability of risk financing, poor infrastructure, absence of vision amongst the stakeholders, and lack of a critical mass of firms (Kharabsheh et al. 2011; Rowe 2014) and talents.

3 Method

3.1 Sample of Science Parks and localised firms

This research aims to analyse the development of Science Parks from the perspective of talent attraction activities. In order to encompass different contexts, such as economic and cultural, a questionnaire was sent in June 2018 to 120 IASP full member parks in Brazil and in Europe and had remained available until September. After discussions with IASP, the questionnaire, including a section about talent attraction, could be included into “2018 IASP General Survey on Science and Technology Parks and Areas of Innovation” and targeted these 120 parks. The possibility was to (1) ensure a relevant Science Park population and (2) to get a better response rate due to IASP support.

Table 1 summarises the entire sampling frame, including the respondent characteristics. The sampling resulted in 59 parks. The parks are located in Austria, Bulgaria, Finland, Latvia, Lithuania, Serbia, Slovenia and Switzerland (one each); Denmark, Estonia, Germany, Greece, the Netherlands and Poland (two each); Portugal (three); Italy and the United Kingdom (four each); Brazil and Sweden (five each); and France, Spain and Turkey (six each). The table reveals a response rate of 50.4%, and the parks were started ca 20 years ago (mean). The oldest park started in 1983, and the youngest park started in 2015. The park management mean is ca 23 employees; however, the park management employees vary between 3 and 108 employees in the surveyed parks. Total employment in the responding 59 the parks (firms and park management) is 217,055 employees. Seventy-seven per cent of the parks have an incubator, and 8% also have research institutes localised in the park. Most of the parks have some sort of collaboration with a local university, and 14.9% are medium firms.

Of the non-respondent Science Parks (58 parks), three parks are invalid: two parks are not Science Parks but incubators, and one park is not a full member of IASP (only a ‘general contact’). To ensure the sample did not show any significant differences between the Science Parks founded in different years, total number of firms located in each park, total number of employees in each park and park management in each park, an independent samples *t* test was conducted to compare the means between two unrelated groups of the same variable. The tests showed (Levene’s test for equality of variances and T-test for

Table 1 Descriptive statistics of the surveyed Science Parks 2018

1. Science Parks—sample and response rate

N (population): 120	No valid Science Parks: 3
n (response): 59	Response rate (%): 50.43
No response: 58	

	Response			No response			
	59 parks			58 parks			
	N	Mean	Std	N	Mean	Std	Sig. (2-tailed)
2. Science Parks—business data							
Science Park start year	59	1997.64	8.92	56	2001.75	10.96	0.029*
Total number of firms in each park	59	157.8	129.92	55	358.15	1706.01	0.370
Total number of employees in each park	58	3742.33	5188.57	33	3335.48	4788.97	0.713
Park management in each park[a]	59	22.85	22.29	34	17.38	25.10	0.280

	Mean	Std
3. Science Park location and university collaboration		
Your Park/Area is located[b]:		
On a university (or other Higher Education Institution) campus:	0.27	0.45
On land or premises owned by a government:	0.30	0.46
On land or premises owned by a private firm:	0.14	0.35
Other:	0.29	0.46
	1.00	
Incubator localised in the Science Park[b]:	0.77	0.43
Research institute localised in the Science Park[b]:	0.08	0.27
The Science Park's core activity is business incubation[b]:	0.27	0.45
The incubator in the Park/Area supports its start-ups in the search for qualified professionals[c]:	3.54	1.13
Capacity utilisation of the Science Parks[d]:	77.12	19.48
Plan to expand the Science Parks capacity[b]:	0.85	0.36
Collaboration with universities[b]:		
Scientific infrastructure	0.61	0.49
Common services	0.58	0.50
Research groups	0.61	0.49
Formal agreements	0.83	0.38
No relationship	0.03	0.18

*$p < 0.05$

[a]Number

[b]Yes (1), No (0)

[c]1–5

[d]Percent

equality of means, sig. two-tailed) only one significant difference (0.05 level) between the response and no response Science Parks: Science Park start year. The respondent parks are somewhat older than their younger counterparts. Apart from this, the table below reveals no substantial differences.

To conclude, although there is no universally accepted definition of an SME, the surveyed 59 Science Parks mainly consist of SMEs. The definitions used vary among countries, but they are most often based on employment. In general, an SME is considered to have fewer than 500 employees. Some countries differentiate between manufacturing and service SMEs. Some countries distinguish between autonomous SMEs and those connected to a larger enterprise or group or identify an SME in terms of management structure. Statistical definitions of SMEs often differ from those used for policy implementation purposes; for example, although a firm with 600 employees may not be regarded as an SME for statistical purposes, the firm may still be able to gain access to public support programmes designed for SMEs.

The European Commission defines medium-sized firms as those firms employing between 50 and 249 workers (European Commission. 2013),[3] but several studies of both US and European medium-sized firms (Acs and Audretsch 1988; Arend 2006; Dickson et al. 2006) followed the US definition and included in their sample firms employing up to 500 employees. Our sample consists of mainly micro firms (< 10 employees): 55%. However, also large firms (> 249 employees) are located in the parks, accounting for 3.46%. The definition of firm size in this paper is in line with the EU definition. It can be noted that most of the localised firms are micro firms or small firms (1–49 employees: 86.2%) (see Table 5 in the “Appendix”).

Localised firms are active in the technology sectors electronics, biotechnology, energy, chemistry and chemicals, electrical power, computer science and hardware, information and communication technology, health and pharmaceuticals, consulting and advice, environment, micromachines and nanotechnology, software engineering, manufacturing and automation technologies, optics, military and defence, and food sciences.

3.2 Data collection, validity, reliability and measures

In order to collect the data, we developed a survey questionnaire in two steps before finalising it. First, we discussed our model in order to measure quantitatively. Then, the questionnaire was thoroughly pretested by the current CEO of Mjärdevi Science Park, in Sweden, in order to identify uncertainties and avoid misunderstandings in the final survey. We asked CEOs to verify the items because our research aims at park level responses, so we expect respondents to be at a level equivalent to a park director, president or manager.

After the results of the pre-tests and the required adjustments, we contacted IASP to request support in administering the survey. The first meeting was held in December 2017 by Skype, with the participation of the director-general and chief operations officer of IASP. In this first meeting, we presented our survey proposal and the desired objectives to be achieved. Because of the alignment of our research with park needs,

[3] ‘Epp.Eurostat.Ec.Europa.Eu/statistics_explained/index.php/small_and_medium-sized_enterprises, feb 13, 2013’.

IASP agreed to support us. Then, our questionnaire was reviewed and verified by IASP professionals in order to be integrated into the annual IASP questionnaire. IASP then sent a link to the online survey with our questions to 120 of its full-member parks, and it remained open for answers from June to September 2018. IASP was responsible for reminders and contacts with park managers until the end of the survey.

Campbell and Cook (1979) define validity as the best available approximation to the truth or falsity of a given inference, proposition or conclusion. While questionnaires tend to be strong on reliability, the artificiality of the survey format reduces validity. This study included 59 Science Parks, and the sample was biased in that not all Science Parks are objectively represented through random sampling. In such a statistical sample of a population, not all participants are equally represented (i.e. sample selection bias may be present). Sampling bias undermines the external validity of a test, i.e. the ability to generalise the results to apply to the full population of 345 full-members of IASP around the world regarding Science Parks in 2018, while selection bias mainly addresses internal validity as related to the differences and similarities found within the sample.

We considered 22 variables, including eleven independent variables, five control variables, and six variables of Science Park performance—success dimensions. All variables are listed in Table 2. Most items were measured according to 1–5 Likert-type scales. Since Science Park managers' perceptions are difficult to capture in terms of dichotomies, such as "agree/disagree," "support/oppose," "like/dislike," or Likert scales, the measures are only approximate indicators. The factorial validity (assessed by the percentage of variance explained) has the same behaviour as reliability regardless of the sample size and the correlation between items. Both reflective and formative measures can be associated with a particular construct (Fornell and Bookstein 1982). Furthermore, factor analysis normally assumes a reflective scale model and does not test for any alternative model for inter-item relation. The principal reason for assuming a reflective model over a formative model is because clusters of beliefs are generally interrelated. The variables in our study are as follows:

Independent variables These variables are responsible for measuring the influence of (1) triple helix actors, such as local governments, universities (including student communities and alumni networks), and (2) talent characteristics when developing activities to select them for tenant firms. *Dependent variables* Dependent variables are indicators of the level of performance (success) achieved by Science Parks.

Control variables The five control variables are included to isolate the effects of Science Park performance—success dimensions, which consisted of measures of alternative data from IASP regarding Science Park age, number of firms therein, park management (number), the total number of employees (size) and business incubation (core activity).

The forthcoming statistical analysis consists of three steps. First, we apply factor analysis (principal axis factoring) to convert potentially correlated variables into linearly uncorrelated ones (factors) (see Tables 6, 7 in the "Appendix"). Moreover, the Kaiser–Meyer–Olkin measure is calculated to determine sampling adequacy. A correlation analysis identifies statistically significant measures (factors and control variables). Finally, regression analysis is used to test the link between the dependent and independent factors.

Table 2 Variables in the study

	Mean	Std	Measure
Science Park stakeholders			
1. Science Park receives support from government agencies to internationalise the Park brand	3.02	1.12	1–5
2. The government demands some directions in the orientation of the Science Park, e.g. military products	2.29	1.15	1–5
3. Science Park collaborates with recruiting firms to find talent for tenant firms	2.98	1.18	1–5
4. The local university is the primary source of talents for Science Park firms	3.64	1.03	1–5
5. Interacting directly with student communities is the most efficient way to reach out and attract university students	3.85	0.91	1–5
Characteristics when selecting talent for tenant firms			
6. Scientific and technological expertise	4.22	0.85	1–5
7. Business experience	4.27	0.89	1–5
8. Creativity and cognitive skills to generate new ideas and knowledge	4.41	0.79	1–5
9. Leadership	4.31	0.84	1–5
10. Communication and cooperate skills	4.29	0.79	1–5
11. Behavioural aspects, such as drive and motivation	4.39	0.74	1–5
Control variables			
12. Science Park—age	20.17	8.86	Years
13. Science Park—number of firms	157.89	129.92	Number
14. Science Park—park management	22.85	22.29	Number
15. Science Park—total number of employees	3742.33	5188.57	Number
16. Science Park—business incubation	0.27	0.45	Yes/No[a]
Science Park performance—success dimensions			
17. An increasing number of successful tenant firms	4.64	0.52	1–5
18. An increasing number of employees in the tenant firms	4.32	0.75	1–5
19. Success in obtaining funding for R&D projects	4.24	0.80	1–5
20. Successful technology transfer processes	4.25	0.71	1–5
21. Increased collaboration between Science Park firms and the local university	4.42	0.65	1–5
22. Increase in innovation activities, e.g. number of patents, new to market products	4.31	0.68	1–5

[a] 1/0

4 Results

4.1 Factor and correlation analysis

We begin with the factor analysis. However, there are only 59 observations (Science Parks) in the sample, and what constitutes an adequate sample for empirical statistical analysis is somewhat complicated. Preacher and MacCallum (2002) acquire good results with very small sample sizes ($p > n$), whereas Mundfrom et al. (2005) find some cases in which a sample size of $n > 100p$ is necessary. Consequently, under the right conditions, many fewer observations can be accepted in contrast to traditional guidelines, and studies suggest that the required sample size depends on the number of factors, the number of variables associated with each factor and how well the set of factors explains the variance in the variables (Bandalos and Boehm-Kaufman 2010). Opinions are also different regarding the ideal value of Cronbach's alpha (reliability). Some experts recommend a value of at least 0.900 for instruments used in clinical settings (Bernstein and Nunnally 1994). Others suggest that an alpha of 0.700 is acceptable for a new instrument (DeVillis 1991; DeVon et al. 2007). According to Hair et al. (2006), the agreed-upon lower limit for Cronbach's alpha is 0.700; however, this may decrease to 0.600 in exploratory research. George and Mallery (2003) provide the following parameters: '$\alpha > 0.900$—Excellent, $\alpha > 0.800$—Good, $\alpha > 0.700$—Acceptable, $\alpha > 0.600$—Questionable, $\alpha > 0.500$—Poor, and $\alpha < 0.500$—Unacceptable' (p. 231).

Factor analysis with principal axis factoring, varimax rotation, was used in this study and such exploratory procedures are more accurate when each factor is represented by multiple measured variables, with an ideal of three to five measured variables per factor (MacCallum 1990; Safón 2009). The factor analysis (see Tables 6, 7 in the "Appendix") revealed five factors (latent variables), and two of these factors are related to stakeholders, namely: Science Park stakeholders—government ($\alpha = 0.706$) and Science Park stakeholders—university ($\alpha = 0.532$) while Tenant firms—talent characteristics ($\alpha = 0.844$) is related to Characteristics when selecting talent for tenant firms. Science Park performance—success dimensions revealed two factors: Successful tenant firms ($\alpha = 0.725$) and Successful innovation and technology transfer ($\alpha = 0.679$). All KMO (Kaiser–Meyer–Olkin) values are above 0.600, and all test statistics for Bartlett's test of sphericity are 0.000. Considering these statistical results together, we decided to use five factors in the forthcoming analysis. We performed a Pearson correlation analysis to predict initial factorability and to identify the statistically significant factors (latent variables) and control variables (at least at the 0.05 level, see Table 3). Table 8 shows correlations on the variable level between the 22 variables in the study.

Two of the five control variables are significant to either Successful tenant firms and Successful innovation and technology transfer. The factor Successful tenant firms is correlated to the factor Tenant firms—talent characteristics, and the factor Successful innovation and technology transfer is correlated to the factors Science Park stakeholders—government and Science Park stakeholders—university.

4.2 Regression analysis

Table 4 presents the results of the regression analyses we conducted to analyse our two research questions. This is the third step in the statistical analysis, based on the five factors constructed from the aggregated statistical means of underlying measures (individual variables) and two of the control variables. The regression model below tests the relationship

Table 3 Correlation matrix

	1.	2.	3.	4.	5.	6.	7.	8.	9.
1. Science Park stakeholders—government									
2. Science Park stakeholders—university	.087								
3. Tenant firms—talent characteristics	.130	.250							
4. Science Park—age	−.085	−.313*	−.003						
5. Science Park—number of firms	−.020	.066	.106	.328*					
6. Science Park—park management	.129	−.014	−.016	.070	.127				
7. Science Park—total number of employees	−.043	.045	−.004	.036	.539**	.065			
8. Science Park—business incubation	.060	.051	.187	.045	−.126	−.037	−.303*		
9. Successful tenant firms	.050	.160	.438**	.246	.331*	.086	.078	.018	
10. Successful innovation and technology transfer	.393**	.343**	.219	−.265*	.085	.066	.013	.009	.360**

*$p < 0.05$, **$p < 0.01$

between the dependent variables of Science Park success dimensions and the independent variables of Science Park stakeholders and characteristics when selecting talent for tenant firms:

$$SS = \beta 0 + \beta_1 SG + \beta_2 SU + \beta_3 TC,$$

where SS = Science Park performance—success dimensions, SG = Science Park stakeholders—government, SU = Science Park stakeholders—university, TC = Tenant firms—talent characteristics

Table 4 indicates four significant regression models, and the four regression models are strongly significant ($p < 0.005$). In model 2, we added the control variable Science Park –Number of firms, which correlated to the Successful tenant firms' factor. In models 1 and

Table 4 Regression analysis

	Model 1[a]	Model 2[b]
Dependent variable: Successful tenant firms; unstandardised coefficient betas and standard errors (between parentheses)		
Science Park stakeholders—government	− .0.006	0.000
	(0.070)	(0.067)
Science Park stakeholders—university	0.039	0.030
	(0.089)	(0.086)
Tenant firms—talent characteristics	0.132***	0.123***
	(0.039)	(0.038)
Intercept	5.528***	5.149***
	(1.092)	(1.047)
Science Park—number of firms		0.003*
		(0.001)
Adjusted R square	0.150	0.221
	Model 3[c]	Model 4[d]
Dependent variable: Successful innovation and technology transfer; unstandardised coefficient betas and standard errors (between parentheses)		
Science Park stakeholders—government	0.361***	0.349**
	(0.119)	(0.119)
Science Park stakeholders—university	0.363*	0.295
	(0.152)	(0.159)
Tenant firms—talent characteristics	0.056	0.064
	(0.066)	(0.066)
Intercept	11.147***	12.259***
	(1.853)	(2.021)
Science Park—Age		− 0.037 (0.028)
Adjusted R square	0.220	0.230

*$p < 0.05$, **$p < 0.01$, ***$p < 0.005$

[a]Sig. 0.007**

[b]Sig. 0.001***

[c]Sig. 0.001***

[d]Sig. 0.001***

2, where the dependent factor is Successful tenant firms, the Tenant firms—talent characteristics factor is strongly significant and positively related to the dependent variable. The control variable, Science Park—number of firms, is also significant and positively related to Successful tenant firms.

In regression models 3 and 4, where the dependent factor is Successful innovation and technology transfer, the factor Science Park stakeholders—government is strongly significant and positively related to Successful innovation and technology transfer. Furthermore, the factor Science Park stakeholders—university, in model 3, is significant and positively related to Successful innovation and technology transfer. However, the control variable in model 4, Science Park—Age, which was correlated to Successful innovation and technology transfer, is not significant. The adjusted R squares for the four models are 15.0, 22.1, 22.0 and 23.0%.

As a result, we conducted testing to verify these findings. Highly collinear or linearly related predictors can cause problems with regression coefficient estimates, and multicollinearity occurs in regression analysis when there is a high correlation between at least one independent variable and a combination of the other independent variables. Table 9 in the "Appendix" shows the collinearity statistics (tolerance and variance inflation factor—VIF). A VIF above 5 is generally considered evidence of multicollinearity, and a tolerance below 0.20 is a cause for concern, but we could not find any indication of multicollinearity in the statistical analysis.

5 Discussion

The statistical analysis presented results in two main levels: stakeholder and individual levels. On the stakeholder-level, the two factors Science Park stakeholders—government and Science Parks stakeholders—university are not relevant for the factor Successful tenant firms. However, they have a significant positive effect on the factor Successful innovation and technology transfer (i.e. Science Park success), which consists of obtaining R&D projects, processes of technology transfer, collaborations between Science Park and the local university, and innovation, such as patents. Thus, stakeholders, government and university, play an important role in supporting and transferring innovation and technology, although a direct relationship between them and the success of tenant companies is not perceived, probably because park management would be responsible for being the interface between them.

On the individual-level, the factor Tenant firms—talent characteristics, which consists of six individual variables (see Table 2), is not important for the factor Successful innovation and technology transfer, but it has a significant positive effect on Successful tenant firms, which consists of an increasing number of successful tenant firms and an increasing number of employees in the tenant firms. Two of the five control variables, which showed to be correlated with the dependent variables, were chosen to compose the models. The number of firms was chosen to compose Model 2 as a control variable because it is significant and has a positive effect on the dimension of Successful tenant firms. The control variable Science Park Age is non-significant in Model 4, although it correlates with the factor of Successful innovation and technology transfer.

The four models correlate the success of Science Parks with the interactions with their stakeholders, as well as with the characteristics of the talents selected by park firms. The underlying questions that led us to construct the models referred to understanding how the success of Science Parks is affected by the collaboration with their stakeholders as well as by the characteristics of the selected talent. The analysis of the models indicated that the collaboration between parks and their stakeholders, represented in this study by the government and local universities, has a positive effect on the process of innovation and technology transfer in the park, which is in line with Lindelöf and Löfsten (2004). The government plays its role in demanding some directions in the orientation of the parks, for instance, requiring research related to the development of military products. The government can also influence the research areas of the park through funding offers for R&D projects or facilitating the process of transferring the technology developed in universities (Klofsten and Lindholm Dahlstrand 2002). In addition, government agencies can assist in communicating the brand of the park in the international arena in order to attract multinational firms to install a branch office or a research centre in the park. Models 3 and 4 have shown that such government activities are positively related to the success of Science Parks (Successful innovation and technology transfer).

The university, in turn, has confirmed its role as a source of knowledge resources and talent (Hommen et al. 2006; Ryder and Leach 1999) for park firms, and this highly qualified human resource is the primary factor of business attraction (Andersson et al. 2009). Informal connections to local universities are useful for recognising academic abilities, accessing knowledge, building links with faculty members and reaching out to students (Padilla-Meléndez et al. 2013). University students and academics are coveted human resources, as they are vital for the development of new knowledge and technologies needed for innovation (Florida 1999). Talents bring fresh ideas into the firms' goods and processes, and technology makes firms more competitive (Klofsten and Lindholm Dahlstrand 2002).

Furthermore, students at a university are more active—and thus more accessible—in their communities than in university departments. Interacting directly with student communities shortens the path to creating efficient connections with students (Cadorin et al. 2017). Moreover, talent characteristics, described by the six individual variables, have a positive effect with regard to the growing number of successful tenant firms as well as of workers in tenant firms. It is perceived that parks interact with a variety of internal and external stakeholders in the quest for talent, and there is not necessarily a need to operate in conjunction with recruitment firms.

This study measures park performance, dividing the Science Park success concept into two factors: (1) Successful tenant firms and (2) Successful innovation and technology transfer. Despite the lack of uniformity over the objectives of Science Parks and the methods to measure the performance of Science Parks, few studies have made substantial contributions to identifying the critical performance factors and empirically examining these effects (see Albahari et al. 2013; Bigliardi et al. 2006; Weng et al. 2019). The literature does not present a clear definition of Science Parks (Quintas et al. 1992), being their characteristics depend on the host country, level of regional development, fields of operations and industry characteristics (Spolidoro and Audy 2008). The lack of uniformity about the objectives of the Science Parks limits the possibilities of carrying out a more precise evaluation. Universities expect Science Parks to commercialise results from researchers, such as patents and licenses, while the located firms and entrepreneurs are searching for short-term projects with the university that can be delivered to the market. In both cases, the synergy between Science Park and the local university should be productive and thus contribute to the success of the park (Jonsson 2002).

6 Conclusions

This paper aimed to investigate how the success of Science Parks is affected by stakeholder collaborations and by the characteristics of the selected talent. The study showed that to become successful, Science Parks should involve stakeholders, like government and universities, in their activities in order to promote innovation in the park and develop efficient technology transfer processes. In addition, special attention should be given to the characteristics of the talents that are selected for tenant firms in order to support the development of tenant firms better. Engaging universities and government contribute to obtaining funding for R&D projects (Link and Scott 2003), facilitates the flow of talent and technology (e.g. publications and patents) from universities to tenant firms, and also promotes innovation and entrepreneurial culture in the park (Hansson et al. 2005).

The characteristics of the selected talent proved to be essential to the success of tenant firms. Indeed, when activities are carried out to select new employees for tenant firms, it is fundamental to consider the skills of the individual. By attracting highly qualified people—see characteristics in Table 2—this will contribute to the development and success of the receiving firm. However, the growth and success of tenant firms is not only the direct result of hiring new talent, but it is also the result of strengthening the talent pool of the park with new and better talent. Moreover, the more firms a park hosts, the higher the likelihood of increasing the number of successful tenant firms. Moreover, an increasing number of firms in the park provides greater exposure to the park's image in national and international scenarios, raising its profile to helps attract more and better-structured firms.

7 Policy implications and further research

The positive effect that Science Parks have on the performance of tenant firms can be found in many studies (Huang et al. 2012; Löfsten and Lindelöf 2002; Siegel et al. 2003; Squicciarini 2008, 2009; Vásquez-Urriago et al. 2014). However, it is not feasible to find articles that, when studying the process of attraction of talents undertaken by Science Parks, consider the interactions with the park's stakeholders as well as the talent characteristics to improve park performance. Our study showed the importance of stakeholders, especially governments and universities, in generating innovation, promoting the parks, and drive the park towards success.

At the stakeholder-level, the government has a role in obtaining funding for R&D projects, supporting technology transfer processes, promoting collaboration between tenant firms and universities and, finally, fostering innovation activities in the park. Park managers should then strengthen their relationship with government representatives at all levels in order to get the necessary support for park development. The benefits received can be financial contributions or even actions to internationalise the brand of the park. Digital tools that make use of the internet, such as social media, or even intensify the participation of the park in international events can be used for this purpose.

In addition, park managers should also be aware of the strategic projects created by government representatives, for example, armed forces and development agencies, as these projects demonstrate the technological needs and capabilities that the country wishes to achieve. Thus, alignment of the orientation of the research areas of the park should be performed as much as possible. Finally, universities have proven to be the primary source of talent for park firms and are leaders in successful innovation and technology transfer activities. Park managers should engage in activities to build links with local universities as well as the student community, approaching young talent and attracting them more effectively. In fact, student communities have proven to be the best way to access and communicate directly with students.

At the individual-level, talent characteristics have a positive effect on the number of successful tenant firms and also on the total number of employees in tenant firms, both factors that make up the success of a Science Park. Indeed, talents with the skills that are highlighted by the surveyed parks are the ones that can drive firms to a higher level, promoting an increase in the number of successful firms in the park. In this way, Science Park managers need to understand the talent needs of tenant firms in order to make the attraction process more effective and reach individuals who actually have the characteristics that firms desire.

Literature is scarce regarding studies of how Science Parks use different forms of association and interaction with their stakeholders in order to attract talent to their tenant firms, to promote innovation and to achieve desired success. This study has several limitations, which also offer promising avenues for future research. Our survey data is based on a single point in time, but the five factors in our study will evolve through a process of interaction. Hence, this study could not capture the evolving nature of stakeholders, talent attraction and successful Science Parks. Therefore, future research could explore the multidimensionality of these processes and also describe them over time. Mainly, longitudinal qualitative studies should be conducted to allow for a better understanding of the interplay between independent and dependent factors over time.

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Appendix

See Tables 5, 6, 7, 8 and 9.

Table 5 Localised firms in the surveyed 59 Science Parks 2018

	Percent	Mean[a]	Std
1. Localised firms in the Science Parks: means and standard deviations			
Total number of firms located: 9,284			
Firm size, located firms in 2018			
Micro firms (1–9 employees)	55.00	106.88	129.54
Small firms (10–49 employees)	31.15	58.92	74.10
Medium firms (50–249 employees)	10.39	16.63	25.37
Large firms (> 249 employees)	3.46	5.44	7.88
	100.00		
2. Firms that have moved into the Science Park during 2015–2017:			
Firm size			
Micro and small firms (1–49 employees)	81.47	51.42	69.44
Medium firms (50–249 employees)	14.90	9.41	17.27
Large firms (> 249 employees)	3.63	2.29	6.91
	100.00		

[a]Number of firms

Table 6 Factor analysis: principal axis factoring with Varimax rotation (rotated factor matrix)

Variables	Factor 1	Factor 2	Factor 3
Factor names	Tenant firms—talent characteristics	Science Park stakeholders—government	Science Park stakeholders—university
Cronbach α	α = 0.844	α = 0.706	α = 0.532
Variable[a]			
1.	− .0.90	**0.918**	0.074
2.	0.155	**0.606**	− 0.223
3.[b]	0.178	0.241	0.090
4.	0.105	0.375	**0.424**
5.	0.077	− 0.107	**0.908**
6.	**0.654**	− 0.037	0.441
7.	**0.643**	− 0.068	0.079
8.	**0.668**	0.240	0.154
9.	**0.645**	0.172	− 0.037
10.	**0.809**	0.004	0.046
11.	**0.673**	0.287	0.011

Bold values indicate highest factor loadings

Science Park stakeholders and characteristics when selecting talent for tenant firms

Cumulative variance 63.072%

(Cronbach α) > 0.500

KMO = 0.730 and Bartlett's test of sphericity = 0.000

[a]See Table 2

[b]Factor loading < 0.300. Excluded from further analysis

Table 7 Factor analysis: principal axis factoring with Varimax rotation (rotated factor matrix)

Variables	Factor 1	Factor 2
Factor names	Successful innovation and technology transfer	Successful tenant firms
Cronbach α	α = 0.649	α = 0.725
Variable[a]		
17.	0.091	**0.683**
18.	0.298	**0.850**
19.	**0.728**	0.193
20.	**0.663**	0.037
21.	**0.424**	0.135
22.	**0.508**	0.185

Bold values indicate highest factor loadings

Science Park success dimensions

Cumulative variance 75.273%

(Cronbach α) > 0.500

KMO = 0.649 and Bartlett's test of sphericity = 0.000

[a]See Table 2

Table 8 Correlation matrix on the variable level between the 22 variables in the study

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
Science Park stakeholders																					
1. SP receives support from gov't agencies to internat the Park brand																					
2. Gov't demands some directions in the orientation of the SP	.546**																				
3. SP collaborates with recruiting firms to find talent for tenant firms	.260*	.144																			

Table 8 (continued)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
4. The local university is the primary source of talents for SP firms	.349**	.161	.037																		
5. Interacting directly with student communities is the most efficient way to reach out and attract university students	−.040	−.273*	.110	.366**																	
Characteristics when selecting talent for tenant firms																					
6. Scientific and technological expertise	−.040	−.013	.158	.228	.446*																

Table 8 (continued)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
7. Business experience	−.109	.125	.070	.013	.181	.512**															
8. Creativity and cognitive skills to generate new ideas and knowl	.128	.211	.211	.308*	.112	.530**	.307*														
9. Leadership	.123	.159	.197	.108	.017	.340**	.514**	.383**													
10. Communication and cooperate skills	−.064	.116	.153	.086	.087	.571**	.502**	.638**	.466**												
11. Behavioural aspects, such as drive and motivation	.178	.251	.165	.229	.039	.379**	.386**	.547**	.582**	.511**											
Control variables																					
12. Science Park—age	−.085	−.064	.061	−.343**	−.164	−.039	.181	−.303*	.156	.077	−.120										

Table 8 (continued)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
13. Science Park—number of firms	.094	−.128	.048	.193	−.103	.105	.041	.045	.147	.094	.042	.328*									
14. Science Park—park management	.082	.144	−.337**	.038	−.068	−.024	.069	−.171	.027	−.166	.193	.070	.175								
15. Science Park—total number of employees	.084	−.155	.077	.080	−.012	-050	−.017	−.047	.030	.024	−.064	.036	.604**	.135							
16. Science Park—business incubation	.059	.047	−.154	−.011	.104	.021	.115	.024	.282*	.165	.246	.045	−.126	−.037	−.303*						
Science Park performance—success dimensions																					

Table 8 (continued)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
17. An increasing number of successful tenant firms	−.108	−.057	−.038	.082	.140	.337**	.176	.192	.335**	.213	.367**	.111	.221	.193	.014	.052					
18. An increasing number of employees in the tenant firms	.157	.090	.045	.173	.073	.344**	.151	.240	,417**	.335**	.419**	.297*	.351**	−.002	.108	−.008	.609**				
19. Success in obtaining funding for R&D projects	.343**	.264*	−.087	.568**	.147	.150	.078	.228	.252	.109	.191	−.150	.198	.039	.090	−.039	.167	.417**			
20. Successful technology transfer processes	.233	.290*	−.077	.079	−.180	−.066	−.084	.151	−.017	.021	−.028	−.177	−.046	.102	−.059	−.112	.110	.199	.502**		

Table 8 (continued)

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.
21. Increased collaboration between SP firms and the local university	.416**	.088	.100	.359**	.376**	.109	−.023	.196	.012	.094	.259*	−.256	−.012	.062	.005	.191	.149	.210	.336**	.211	
22. Increase in innov act, e.g. number of patents, new to market products	.107	.218	.287*	.109	.105	.151	.090	.280*	.229	.188	.308*	−.187	.080	−.015	−.010	.007	.168	.312*	.344**	.339**	−.329*

SP Science Park

**Correlation is significant (0.01-level), 2-tailed; *Correlation is significant (0.05-level), 2-tailed

Table 9 Collinearity statistics

	Model 1		Model 2	
	Tolerance	VIF	Tolerance	VIF
Science Park stakeholders—government	0.980	1.020	0.979	1.022
Science Park stakeholders—university	0.934	1.070	0.933	1.072
Tenant firms—talent characteristics	0.926	1.080	0.917	1.090
Science Park—number of firms			0.986	1.014
	Model 3		Model 4	
	Tolerance	VIF	Tolerance	VIF
Science Park stakeholders—government	0.980	1.020	0.975	1.026
Science Park stakeholders—university	0.934	1.070	0.839	1.192
Tenant firms—talent characteristics	0.926	1.080	0.918	1.089
Science Park—age			0.891	1.122

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Science Parks and talent attraction management: university students as a strategic resource for innovation and entrepreneurship

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ABSTRACT

This paper aims to expand our understanding of talent attraction management in Science Parks with a specific interest in university students/alumni as a human and strategic resource. The underlying rationale is how the links with universities can be supported and how the Science Park management can contribute to successful relationships with universities and university students/alumni, in order to develop tenant firms and the park itself. A questionnaire was sent out in 2018–120 parks. This study includes 25 variables, and four significant regression models are presented. The main finding is that Science Park talent attraction activities act as a mediating variable, which affects the informal and formal partnerships between students and firms/universities as well as how the park management can contribute to successful relationships. By attracting students, tenant firms can have a positive impact on their performance as well as Science Park development.

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Talent attraction management; Science Park; university; students

1. Introduction

Over the last several decades, scholars have undertaken many studies regarding Science Parks' relevance, networks, and performance from mainly the park, firm, and regional perspectives. One aspect of developing a park that is gaining attention is the attraction of talent, which may include attracting specific knowledge that facilitates the establishment and creation of companies; or reaching skilled workers such as university students. The characteristics of the attracted talent affect the performance of the Science Park, and park managers need to understand the firms' needs better to attract talent effectively (Cadorin, Klofsten, & Löfsten, 2019a). Universities are the primary source of talent; thus, informal and formal cooperation with universities is an important dimension (Bergegal-Mirabent, Ribeiro-Soriano, & García, 2015; Cadorin, Germain-Alamartine, Bienkowska, & Klofsten, 2019b; Hu, 2008).

Although there is no major definition of a Science Park, some concepts describe the phenomenon such as Research Park, Technology Park, Business Park, and Innovation

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Centre (Eul, 1985; Guadix, Carrillo-Castrillo, Onieva, & Navascues, 2016; Monck, Porter, Quintas, Storey, & Wynarczyk, 1988). This study follows the International Association of Science Parks and Areas of Innovation (IASP) definition, which states that a Science Park is 'an organisation managed by specialised professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions'. Feldman (2007) underlines that large firms, as well as incubator-linked Science Parks, represent different kinds of 'innovative platforms'.

Academic literature addresses the definition of talent mainly as objects (characteristics of people) or as subjects (people): 'Object approach includes the ability, capacity, capability, commitment, competency, contribution, experience, knowledge, performance, and potential, patterns of thought, feeling or behaviour, and skills that are related to the characteristics of people' (Gallardo-Gallardo, Dries, & González-Cruz, 2013, p. 293). The subject approach assesses talent by considering either all people in the organization or just an elite subset of the organization's population (Gallardo-Gallardo et al., 2013). Meyers, van Woerkom, and Dries (2013) defined talent through five approaches: giftedness, strength, (meta-) competencies, high potential, and high performance. However, there are several problems in defining talent (Lewis & Heckman, 2006; Thunnissen, Boselie, & Fruytier, 2013). Talent concept comprises people with specific experiences and abilities (Gagné, 2004; Saddozai, Hui, Akram, Khan, & Memon, 2017). Talents are often interested in developing a corporate culture, social networks and organizational structure, all of which are difficult for competitors to copy (Barney, 1995). Talent skills include potential, performance, creativity, competence, and leadership abilities (Saddozai et al., 2017) that can achieve unusual results (Gagné, 1985; Gallardo-Gallardo et al., 2013; Saddozai et al., 2017; Tansley, 2011). High performers or high potential candidates can only be considered talents if they also have exceptional abilities (Thunnissen & Van Arensbergen, 2015).

According to McDonnell, Collings, Mellahi, and Schuler (2017), there is a growing body of literature on talent management. The increasing internationalization of small- and medium-sized firms further increases the competition for talent, especially for individuals with the ability to make accurate judgements and quick decisions (Tarique & Schuler, 2010). There has also been an on-going debate regarding talent management in the academic literature (Boudreau & Ramstad, 2007; Collings & Mellahi, 2009; Groysberg, 2010; Lewis & Heckman, 2006; McDonnell, 2011). Talent management encompasses managing the supply, demand, and flow of talent, and, according to McDonnell et al. (2017), its growing significance appears premised on the assumption that efficient talent management is a key source of competitive advantage.

Cadorin, Johansson, and Klofsten (2017) found that Swedish Science Parks had developed several tools for attracting talent, independently or in collaboration with stakeholders. Despite the interest in Science Parks among researchers, practitioners, and policymakers to promote innovation, entrepreneurship, and regional development, a few studies have focused on Science Park development from the perspective of talent attraction management and the collaboration that occurs in the talent attraction processes (Bellavista & Sanz, 2009; Bonacina Roldan, Hansen, & Garcia-Perez-de-Lema, 2018). In this paper, the underlying rationale is how the links with universities can be supported and how the Science Park management can contribute to successful relationships with universities and university students/alumni, in order to develop tenant firms and the Park itself. For this aim, our research question is:

> ***RQ:*** *how can talent attraction management developed by Science Parks build successful partnerships with students/alumni and universities/firms?*

This study investigates Science Parks in Europe and Brazil to expand our understanding of talent management in the fields of innovation and human and strategic management. We analysed 59 Science Parks in 2018: five parks in Brazil and 54 parks in Europe. A sample of 59 parks positioning this paper in the top 20 percentile of earlier conducted studies using the Science Park as a unit of analysis. All the parks surveyed were IASP full-members, and total employment (among the firms and park management) was 217,055. In the parks surveyed, the number of park management employees ranged from 3 to 108, with a mean of 23 employees. This study contributes to the literature on Science Parks and talent management and addresses policy issues on park management.

This paper is structured as follows. Section 2 presents the literature review, hypotheses and research model. Section 3 describes the sample, methodology, and type of investigation. Section 4 presents the analysis and empirical findings. Section 5 discusses the patterns of the linkages between talent attraction activities of the Science Park management and students and outlines limitations and directions for future studies. Section 6 concludes.

2. Literature review and hypotheses

Collings and Mellahi (2009) develop a theoretical model of strategic talent management that provides a view of talent management, which includes integrated and interrelated processes. However, talent management does not have a clear definition in the literature, and there are several arguments around the types, processes, and elements of talent management. Nevertheless, talent management is a strategic and holistic approach to human resources, business planning, and strategic management. Lewis and Heckman (2006), criticize the variety of definitions that increase confusion around original findings, conclusions, and the purpose of talent management. Boudreau and Ramstad (2005) argue that differential investment in working groups with the term 'pivotal talent' is strategically important and necessary for the organization. Lawler (2008) underlined that talent is critical for innovating, changing, and achieving high performance. Thus, acquiring the right talent is essential as a source of competitive advantage for firms.

The firm's competitive advantage relies mainly on its ability to innovate and its human resources, and Science Parks have a high concentration of resources (Cheba & Hołub-Iwan, 2014; Ferguson & Olofsson, 2004; Holland, Sheehan, & De Cieri, 2007; Siegel, Siegel, & Macmillan, 1993). In order to meet company needs, human resource management introduced a new strategic level named talent management, which focuses on this special group of people rather than the entire company (Saddozai et al., 2017). The main objective of talent management practices is 'to attract, develop, motivate and retain talent' (Thunnissen et al., 2013, p. 1752). However, previous research has been criticised for being fragmented with a narrow focus on human resource activities. Moreover, an analysis that considers human resources as a system is still unusual in the research literature (Lau & Ngo, 2004; Laursen & Foss, 2003). In organizations, developing business strategies, directing and acting, arranging conditions to compete, and making the right decisions depend on owned talent and the efficiency of their competencies. Business accomplishments and the creating and executing of strategies depend on the depth and quality of the talent in the organization (Collins, 2001).

According to Phan, Siegel, and Wright (2005), company maturity imposes different talent needs. More mature firms demand a wide-ranging of talents (Siegel et al., 1993) to improve existing processes through contact with innovative ideas of young mindsets (Klofsten & Jones-Evans, 1996), and the park and its local university offer a continual flow of graduates (Etzkowitz, 2008; Florida, 1999). The assessing of academic knowledge is a fundamental principle of Science Parks (Lindelöf & Löfsten, 2005; Löfsten & Lindelöf, 2002). Younger companies often lack technical or managerial competence in their teams (Bøllingtoft & Ulhøi, 2005), relying more on Science Park support to find professionals with specific skills, managers or CEOs (Zhu & Tann, 2005). Experienced entrepreneurs provide the skills needed to strengthen the academic spin-off team in its early stages of development (De Cleyn, Braet, & Klofsten, 2015). Understanding the nature of talent and selecting those appropriate for organizations has become critical to business survival. (Cappelli, 2008; Thunnissen et al., 2013). Svensson, Klofsten, and Etzkowitz (2012) explore the dynamics of change among the triple helix actors that involves building consensus within the city and with its neighbouring city.

The concept of linkage among universities, academic research, and firms is central to the Science Park model (Albahari, Klofsten, & Rubio-Romero, 2019; Quintas, Wield, & Massey, 1992). Science Parks are important actors in entrepreneurial ecosystems because they establish a mixture of stakeholder relationships among universities, firms, governmental agencies, incubators, and other parks (Albahari et al., 2019; Cadorin et al. 2019a). In addition, the environment provided by Science Parks is conducive for companies to build a collaborative network and maximize the results of their talent management activities (Hu, 2008; Schweer, Assimakopoulos, Cross, & Thomas, 2012), which contributes to the park's talent attraction factor.

Science Parks support and stimulate the exchange of knowledge and talent between tenant companies and the local university (Cadorin, Klofsten, Albahari, & Etzkowitz, 2019c). In fact, Colombo and Delmastro (2002) and Westhead (1997) note that Science Parks should focus on the establishment of connections with universities to facilitate access to skilled human capital, such as students with innovative ideas, and academics (Martin-Rios, 2014; Mellander & Florida, 2011; Vedovello, 1997). Hypothesis 1 is therefore formulated as:

> **H1**: *Networking and attracting dimensions is positively related to Science Park talent attraction activities*

Studies have contributed to the knowledge of the positive relationship between human resources and firm performance (Alagaraja, 2013; Jiang, Wang, & Zhao, 2012) and the link between innovation and human resource activity has also been addressed (Beugelsdijk, 2008; Ceylan, 2013; Chang, Gong, Way, & Jia, 2013; Jiang et al., 2012; Jiménez-Jiménez & Sanz-Valle, 2005; Lau & Ngo, 2004). Cooke (2007) underlines that entrepreneurship and talent variables have been understated in the research literature and categorizes regional innovation systems according to the stability of these variables. However, Hommen, Doloreux, and Larsson (2006) found that the entrepreneurial university basically was 'absent from the scene', mainly in the early days of the Science Park.

Hogan (1996) divides performance of Science Parks into two different categories: (i) intrinsic, those related to the attainment of technological synergy, and (ii) extrinsic, related to economic development. Albahari, Catalano, and Landoni (2013), Guadix et al. (2016) and Lee and Yang (2000) discuss other performance dimensions such as years of operation, R&D expenditures, the incomes and the innovation outcomes of the tenant firms, and linkages with local universities and research centres. Bigliardi, Dormio, Nosella, and Petroni (2006) and Guy (1996) highlight the network of partners has a significant impact on Science Park performance. Cadorin et al. (2019a) underlines a major advantage of Science Parks is that the parks offer services that firms find difficult to provide in collaboration with other stakeholders, such as networks with educational and research entities; assist in the subsequent exchange of knowledge; build strategic alliances; attract talent; and discover partners in contracts and agreements. Through the Science Park´s broad network and collaboration with students, researchers, and firms, a Science Park often functions as a mediator between students and firms, such as teaming up students with entrepreneurial ventures for writing theses, internships and job recruitments. Important objectives for the park management is hence to extend the exchange of knowledge and development of joint projects between tenant firms and the university and to enhance informal and formal relationships between students and firms in the Science Park.

In this study, we focus on the characteristics of the relationship among the talents, the park management, and universities/firms and how the talent attraction activities of the Science Parks' management can increase the partnerships (performance) with students and firms/universities. This means that the Science Park talent attraction activities is the focus of our analysis. We hypothesize that Science Park talent attraction activities explain the relationship among the other factors in this study. First, we explicitly focus on Science Park talent attraction activities and suggest that *Networking and attracting dimensions* will foster a fruitful environment and affect talent attraction activities in the Science Park (Hypothesis 1). Second, we propose that Science Park talent attraction activities foster partnerships between talents and universities and/or firms. The process of mediation is defined as the intervention caused by this mediator variable: Science Park talent attraction activities. Hypotheses 2 and 3 can, therefore, be formulated as:

H2: *Science Park talent attraction activities is positively related to Partnerships with talents and firms/universities.*

and

H3: *Science Park talent attraction activities will positively intermediate the relationships among Networking and attracting dimensions and Partnerships with talents and firms/universities.*

The arguments outlined in hypotheses 1, 2, and 3 clarifying that the variable Science Park talent attraction activities serves as a link between H1 and H3 (see Figure 1). Thus, the research model suggests a mediating role for Science Park talent attraction activities and the main objective in the forthcoming analysis is to confirm that this variable functions as a mediating variable.

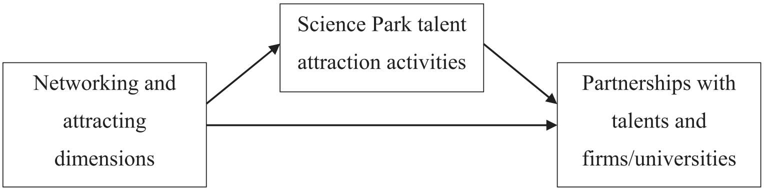

Figure 1. Research model.

3. Sample and method

3.1. Sample of Science Parks

This research is part of the bilateral strategic cooperation agreement between Brazil and Sweden and aims to analyse the development of Science Parks from the perspective of talent attraction management. One aim of this cooperative agreement is to encompass different contexts: economic, political, and cultural. A questionnaire was sent out in June 2018–120 parks in Brazil and Europe, which are IASP full-members and, hence, active Science Parks. The survey remained available until September 2018. After discussions with the IASP team, it was agreed that our questions would be part of the '2018 IASP General Survey on Science and Technology Parks and Areas of Innovation', including an entire section on talent attraction. The goal was to ensure a relevant Science Park population and to get a better response rate by having the IASP team support. IASP was created in 1984 and today has 345 members around the world. IASP has three membership options: full-member, affiliate, and associate. The first considers Science Parks in operation; the second Science Parks under construction; and the third is for those who are not Science Parks.

The sampling resulted in a response of 59 parks of which five in Brazil, one in Austria, one in Bulgaria, two in Denmark, two in Estonia, one in Finland, six in France, two in Germany, two in Greece, four in Italy, one in Latvia, one in Lithuania, two in Poland, three in Portugal, one in Serbia, one in Slovenia, six in Spain, five in Sweden, one in Switzerland, two in the Netherlands, six in Turkey, and four in United Kingdom. Table 1 shows a 50.4 per cent response rate. The oldest park started in 1983, and the youngest park in 2015. Most parks have some sort of collaboration with a local university.

Among those not responding parks (58), three parks were not valid: two were incubators, and one was only a 'general contact'. To ensure the sample did not show any significant differences between Science Parks founded in different years, having a differing number of firms, number of employees, and park management in each park, we conducted an independent sample t-test to compare the means between two unrelated groups of the same variable (Levene's test for equality of variances and t-test for equality of means, sig. two-tailed). To conclude, the only significant difference between responding and non-responding parks was the founding year (significant at the 0.05 level).

The 59 respondent Science Parks host mainly micro or small firms (1–49 employees: 86.2 per cent), being micro firms (<10 employees) accounting for 55 per cent of the total. However, some large firms (>249 employees) are located in the parks as well: 3.46 per cent. The local firms are active in the technology sectors, electronics, biotechnology, energy, chemistry and chemicals, electrical power, computer science and hardware,

Table 1. Descriptive statistics of the surveyed Science Parks, 2018.

1. Science Parks – sample and response rate:							
N (population): 120	No valid Science Parks: 3						
n (response): 59	Response rate (%): 50.43						
No response: 58							
2. *Science Parks – business data*							
	Response 59 parks			No response 58 parks			
	N	Mean	Std	N	Mean	Std	Sig. (2-tailed)
Science Park start year	59	1997.64	8.92	56	2001.75	10.96	0.029*
Total number of firms in each park	59	157.88	129.92	55	358.15	1706.01	0.370
Total number of employees in each park	58	3742.33	5188.57	33	3335.48	4788.97	0.713
Park management in each park[1]	59	22.85	22.29	34	17.38	25.10	0.280
3. Science Park location and university collaboration							
Your Park/Area is located[2]:		*Mean*	*Std*				
On a university (or other Higher Education Institution) campus:		0.27	0.45				
On land or premises owned by a government:		0.30	0.46				
On land or premises owned by a private firm:		0.14	0.35				
Other:		0.29	0.46				
Incubator localized in the Science Park[2]:		0.77	0.43				
Research institute localized in the Science Park[2]:		0.08	0.27				
The Science Park´s core activity is business incubation[2]:		0.27	0.45				
The incubator in the Park/Area supports its start-ups in the search for qualified professionals[3]:		3.54	1.13				
Collaboration with universities[2]*:*							
Scientific infrastructure		0.61	0.49				
Common services		0.58	0.50				
Research groups		0.61	0.49				
Formal agreements		0.83	0.38				
No relationship		0.03	0.18				

Notes: * = $p < 0.05$.
[1] = Number.
[2] = Yes (1), No (0).
[3] = 1–5.

information and communication technology, health and pharmaceuticals, consulting and advice, environment, micromachines and nanotechnology, software engineering, manufacturing and automation technologies, optics, military and defence, and food sciences.

3.2. Data collection and study design

The research team developed a questionnaire in two steps before finalizing it. First, we discussed our model and how to measure the questions quantitatively. Then, the questionnaire was pretested by the current and former CEO of the Mjärdevi Science Park in Sweden to identify uncertainties and avoid misunderstandings in the final survey. We asked the CEOs to verify the questions because the research objective is to capture park level responses. Thus, we expected respondents to be at a level equivalent to a park director, president, or manager. After the results and adjustments in the pre-test, we contacted IASP to request support in the execution of the survey. The first meeting was held on

December 2017 via Skype with the director-general and the chief operations officer of IASP participating. In this first meeting, we presented our survey proposal and the desired objectives. Because of the alignment of our research with park needs, IASP agreed to support the study. Then, our questions were reviewed and verified by IASP professionals to be approved and integrated into the annual IASP questionnaire. IASP then sent a link to the online survey with our questions to its full-member parks in Brazil and Europe. The questionnaire remained open for answers from June to September 2018. IASP was responsible for reminders and contacts with park managers until the end of the survey.

While questionnaires tend to be reliable, the artificiality of the survey format reduces validity. This study includes responses from 59 Science Parks; however, the sample was biased once not all Science Parks were objectively represented through random sampling and in such a statistical sample of a population, not all participants are equally represented (i.e. sample selection bias may be present). Sampling bias undermines the external validity of a test, namely, in this case, the ability to generalize the results to apply to the full population of the 345 IASP full-member Science Parks in 2018. Selection bias mainly addresses internal validity relating to the differences and similarities found within the sample.

When self-report questionnaires are used to collect data at the same time from the same respondents, common method variance may be a concern, which is strongest when both the dependent and explanatory variables are perceptual measures derived from the same participant (Podsakoff & Organ, 1986). Podsakoff, MacKenzie, Lee, and Podsakoff (2003, 2012) analyse some general sources of common method variance: the use of a common rater, the way items are presented to respondents, the context in which items in a questionnaire are placed, and the contextual influences. Our study reduces the risk of common method bias by using different headings and sections among the different items in the questionnaire. Harman's single factor score, in which all items (measuring latent variables) are loaded into one common factor, is also used. If the total variance for a single factor is less than 50 per cent, it suggests that common method variance does not affect the data. However, Harman's approach is to test for common method bias, but not to control for it. None of the factors in our study exceed 50 per cent (one factor: 32.840 per cent).

This study considers 25 variables, including four control variables (see Table 2). Most items are measured according to a five-point Likert-type scale. Since Science Park managers' perceptions are difficult to capture in terms of dichotomies, such as 'agree/disagree', 'support/oppose', 'like/dislike', or Likert scales, the measures are only approximate indicators. Both reflective and formative measures can be associated with a construct (Fornell & Bookstein, 1982). Furthermore, factor analysis assumes a reflective scale model and does not test for an alternative model for inter-item relations. This model was chosen over a formative model because belief clusters are often inter-related.

The 21 variables in Table 2 representing Partnerships with talents and firms/universities, Science Park talent attraction activities and Networking and attracting dimensions are responsible for measuring the influence of (i) talent attraction activities of the Science Park management, (ii) triple helix actors such as local governments and universities (including student communities and alumni networks), and (iii) dimensions for students to remain in the Science Park after graduation, such as opportunities to start businesses and innovative environments. Table 2 presents a summary of the three theoretical

Table 2. Variables used in the study.

(i) Partnerships with talents and firms/universities

Cadorin et al. (2019a) underlines that a major advantage of Science Parks is that the parks offer services that firms find difficult to provide in collaboration with other stakeholders, such as networks with educational and research entities and firms and discover partners in contracts and agreements (partnerships). Science parks are an instrument of interaction between firms and universities, facilitating links to the training and recruitment of qualified manpower for park firms (Vedovello, 1997). Also, park's incubator supports entrepreneurial academics (Huffman & Quigley, 2002) offering facilities (Etzkowitz & Klofsten, 2005; Walcott, 2002; Westhead & Storey, 1995) and business advice (Albahari, Barge-Gil, Pérez-Canto, & Modrego, 2018; Cadorin et al., 2017). In addition, Cadorin et al. (2019b) show that the exchange of knowledge and talent between universities and park companies is one of many activities that parks perform.

(ii) Science Park talent attraction activities

Science Parks offer a favourable environment for firms to adopt a collaborative network improving their talent management practices (Hu, 2008; Schweer et al., 2012). Younger and mature firms benefit from talent activities undertaken by Parks. The former relies on the park's support to recruit skilled professionals to fill the expertise gap of their team (Albahari et al., 2018; Phan et al., 2005). The latter demands a broad spectrum of talents (Siegel et al., 1993) and the park and its local university offer a continual flow of graduates (Etzkowitz, 2008; Florida, 1999).

(iii) Networking and attracting dimensions

The network of relations with universities and its students involves, for example, the promotion of recruitment fairs and events to attract the university alumni network (Cadorin et al., 2019a), as well as the integration between young talent and the management of parks and their tenant companies (Cadorin et al., 2019b). Environmental factors related to the quality of life, such as pleasant and affordable housing and good school options (Lecluyse, Knockaert, & Spithoven, 2019), along with working conditions and opportunities for relationships with other fellow workers (Thunnissen & Van Arensbergen, 2015) are crucial in attracting talent to Science Parks.

Variables	Mean	Std	Measure
1. The management team carries out activities in partnership with the university to enhance informal relationships between students and firms in the Science Park	4.29	0.70	1–5
2. The management team carries out activities in partnership with the university to enhance informal relationships between faculty and firms in the Science Park	4.29	0.70	1–5
3. The management team provides services to promote the exchange of knowledge and the development of joint projects between tenant firms and the university	4.29	0.72	1–5
4. The management team develops specific activities to support the talent-attracting activities of tenant firms	4.10	0.76	1–5
5. The management team is directly or partially involved in the management of the Science Park firms	3.51	1.12	1–5
6. The management team offers services and facilities for incoming firms and their employees, in order to assist them in resolving legal and family issues (housing, schools, medical assistance etc)	3.24	1.10	1–5
7. Attracting prominent firms to the Science Park is an efficient way to attract talent	4.19	0.71	1–5
8. The management team count on university student collaboration in the decision-making process	3.08	1.02	1–5
9. The management team cooperates with student organizations in order to get fresh ideas and spread park information among students	3.85	0.81	1–5
10. The management team develops activities to promote and support entrepreneurial students and researchers	4.36	0.64	1–5
11. The management team develops activities to attract senior professionals to the park tenants	3.71	0.95	1–5
12. The management team works to create a positive flow of foreign talents into the Science Park	3.85	0.96	1–5
13. The management team promotes activities to reach out and attract former university students (alumni network)	3.61	1.00	1–5
14. Influencing students to remain in the park after graduation is an efficient way to attract talent	3.80	0.85	1–5
15. The events and activities promoted by the management team play a relevant role in attracting talent to the Science Park	4.25	0.68	1–5
16. Support and encouragement to start a new business	4.46	0.57	1–5
17. Opportunities to work in an innovative environment	4.66	0.51	1–5
18. Opportunities to work with excellent professionals	4.46	0.60	1–5
19. Opportunities to work in prominent firms	4.36	0.69	1–5
20. Better opportunities to find a job	4.32	0.71	1–5
21. Quality of life facilities, e.g. parks and social meetings places	4.19	0.71	1–5
Control variables			
22. Science Park – age	20.17	8.86	Years
23. Science Park – number of firms	157.89	129.92	Number
24. Science Park – park management	22.85	22.29	Number
25. Science Park – total number of employees	3678.90	5166.67	Number

constructs together with the measures applied in the study, and references to previous studies. The focus of this study is to understand the constructs and the interplay between the constructs stated in hypotheses 1–3 and the main objective is to clarify if Science Park talent attraction activities is a mediating variable. The four control variables are included to isolate the effects of Science Park age and size. These consist of measures of alternative data from IASP regarding Science Park age, the number of firms in the Science Park, park management (number), and the total number of employees in the Science Park (size).

The statistical analysis consists of: (i) factor analysis (principal axis factoring) to convert potentially correlated variables into linearly uncorrelated factors (see Table A1), and to test whether measures selected for each construct exhibited sufficient convergent and discriminating validity; the Kaiser–Meyer–Olkin measure is calculated to determine sampling adequacy; (ii) a correlation analysis (both on the variable level and the factor level) to identify statistically significant measures (factors and control variables), and (iii) four regression analyses to test the links between the factors.

4. Analysis

4.1. Factor and correlation analysis

Considering that there are only 59 observations in this analysis, it is difficult to establish an adequate sample. Analysts sometimes use rules of thumb like the factor analysis requiring 5–10 times as many subjects as variables. However, some studies suggest that the required sample size depends on the number of factors, the number of variables associated with each factor, and how well the set of factors explains the variance in the variables (Bandalos & Boehm-Kaufman, 2009). For example, Preacher and MacCallum (2002) obtained good results with tiny sample sizes ($p > n$); however, Mundfrom, Shaw, and Ke (2005) found some cases where a sample size of $n > 100p$ was necessary. They found that if the number of underlying factors stayed the same, more variables and not fewer, as implied by guidelines based on the observations-to-variables ratio, could lead to better results with small samples of observations. In sum, if the conditions are good, fewer observations can be accepted.

This study uses factor analysis with principal axis factoring (varimax). Exploratory procedures are more accurate when each factor is represented by multiple measured variables in the analysis, with an ideal value of between three to five measured variables per factor (MacCallum, 1990; Safón, 2009). The Kaiser-Meyer-Olkin (KMO) measure is also calculated to determine sampling adequacy. The factor analysis reveals four latent variables (see Table A1). The four strong latent variables are: (1) *Involving tenant firms/students and attracting former students (alumni)* ($\alpha = 0.818$); (2) *Dimensions for students to remain in the Science Park after graduation* ($\alpha = 0.814$); (3) *Informal and formal partnerships with students and firms/universities* ($\alpha = 0.822$); and (4) *Science Park talent attraction activities* ($\alpha = 0.784$).

Although there is no agreement on the lower limit for Cronbach's alpha value, Hair, Anderson, Tatham, and Black (1995) state that 0.700 is the generally accepted value, and this may decrease to 0.600 in exploratory research. Bartlett's test of sphericity is also calculated. These tests provide a minimum standard before conducting a factor analysis (see note c in Table A1). Two factors are dropped from further analysis because they only contain one variable (variable 9: 'The management team cooperates with student organizations in order to get fresh ideas and spread park information among students' and variable 20: 'Support and encouragement to start a new business').

In the second step, we build a correlation matrix using Pearson correlation at the variable level (25 variables) to check the initial correlations (see Table A2 for correlations at the variable level). Then a correlation analysis at the factor level (see Table 3) was performed to identify the statistically significant factors (at least at the 0.05 level). The control variable *Science Park–age* has a statistically significant correlation with *Informal and formal partnerships with students and firm/university*. There are significant correlations between *Science Park talent attraction activities* and *Involving tenant firms/students and attracting former students (alumni)*, *Dimensions for students to remain in the Science Park after graduation,* and *Informal and formal partnerships with students and firms/ universities*.

To estimate the degree to which any two measures are related, typically, researchers use the correlation coefficient. Correlations between theoretically similar measures should be 'high' while correlations between theoretically dissimilar measures should be 'low'. However, one problem with convergent-discrimination arises from the definitions of 'high' and 'low'. In Table 3, there are high correlations among three of the four factors. We can state here that we have convergent validity and high internal consistency (based on Cronbach's alpha).

4.2. Regression analysis

Regression analyses are applied to test the relationships (H1–H3) among the links in the research model (see section 2). Regression analyses are based on latent variables, which are constructed from the aggregated means of the underlying measures. Since all measures are expressed in Likert-type five-point scales, there is little risk of aggregated means being affected by extreme values. In our data analysis, the first step was the factor analysis; the second step was the correlation analysis, and then the third step is to test whether networking and attraction dimensions will have a positive effect on Science Park attraction activities (H1). However, according to the factor analysis, Hypothesis 1 (Networking and attracting dimensions is positively related to Science Park talent attraction activities*)* is modified and can be divided into two hypotheses: H1a and H1b:

Table 3. Correlation matrix: four factors and four control variables.

	1.	2.	3.	4.	5.	6.	7.
1. Involving tenant firms/students and attraction of former students (alumni)							
2. Dimensions for students to remain in the Science Park after graduation	.216						
3. Informal and formal partnerships with park management and students	.380**	.457**					
4. Science Park talent attraction activities	.566**	.486**	.544**				
5. Science Park – age	-.033	-.173	-.312*	-.034			
6. Science Park – number of firms	-.020	.169	.080	.143	.328*		
7. Science Park – park management	-.409**	.000	.003	-.255	.070	.127	
8. Science Park – total number of employees	.052	.123	.055	.143	.036	.539**	.065

Notes: $^*p < 0.05$, $^{**}\ p < 0.01$.

H1a: *Involving tenant firms/students and attracting former students (alumni)* is positively related to *Science Park talent attraction activities*.

H1b: *Dimensions for the students to remain in the Science Park after graduation* is positively related to *Science Park talent attraction activities*.

Hypotheses H2 and H3 are slightly modified according to the factor analysis:

H2: *Science Park attraction activities* is positively related to *Informal and formal partnerships with students and firms/universities*.

H3: *Science Park talent attraction activities* will positively intermediate the relationships among *Involving tenant firms/students and attracting former students (alumni)*, *Dimensions for students to remain in the Science Park after graduation* and *Informal and formal partnerships with students and firms/universities*.

In general, the mediation model examines the relationships between the independent variables and the dependent variable, the relationships between the independent variables and the mediator variable, and the relationship between the mediator variable and the dependent variable. Multicollinearity is typically expected in the analysis of the mediator variable and the dependent and the independent variables and, therefore, is difficult to be avoided by the researcher. Although the mediation caused by the variable is challenging to predict statistically, statistics can be utilized to assess the assumed mediational model developed by the mediator variable.

Baron and Kenny's (1986) procedure is in this study applied to test the mediating effect of *Science Park talent attraction activities* and the four regression models are presented in Table 4. In fact, model 1 shows a positive and significant relationship between each dependent factor and the independent factor. The regression model is supported at the 0.05 significance level, namely, a strong regression model. Both latent variables (factors) in the model are supported at the 0.05 significance level. Hypotheses 1a and 1b are, therefore, supported. The next step is to test the relationship between *Science Park talent attraction activities* and *Informal and formal partnerships with students and firms/universities*. We hypothesize that the former will have a positive effect on the latter (H2). The results are presented in model 2 and show that the independent factor has a strong significant and positive effect on the dependent factor; thus, Hypothesis 2 is supported. The model is supported at the 0.05 significance level. We also hypothesize that *Involving tenant firms/students and attracting former students (alumni)* and *Dimensions for the students to remain in the Science Park after graduation* are positively and significantly related to *Informal and formal partnerships with students and firms/universities* (H3). Model 3 is significant at the 0.05 level, and both the independent factors are positively significant.

When the *Science Park talent attraction activities* is introduced in the regression analyses, the two independent factors weaken and *Involving tenant firms/students and attracting former students (alumni)* is not significant. However, the mediating variable is positive and significant, and the model is strongly significant. Thus, Hypothesis 3 is also supported. In sum, conditions 1 and 2 are met (see models 1 and 2), as are conditions 3 and 4 (see models 3 and 4). The analysis shows that the mediating variable (*Science Park talent attraction activities)* represents a partial mediation and it happens when the mediating variable is responsible for a part of the relationship between the independent and the dependent variables. However, Baron and Kennýs four steps (requirements) are met.

Table 4. Regression analyses. Unstandardized coefficients beta and standard errors (in parentheses).

	Model 1[a]			Model 2[b]			Model 3[c]			Model 4[d]		
		Tolerance	VIF		Tolerance	VIF		Tolerance	VIF		Tolerance	VIF
Involving tenant firms/students and attraction of former students (alumni)	0.312*** (0.065)	0.953	1.049				0.165* (0.065)	0.953	1.049	0.072 (0.074)	0.675	1.482
Dimensions for the students to remain in the Science Park after graduation	0.343*** (0.091)	0.953	1.049				0.308** (0.090)	0.953	1.049	0.205* (0.097)	0.759	1.318
Science Park talent attraction activities				0.474*** (0.097)	1.000	1.000				0.300* (0.128)	0.540	1.850
Intercept	1.722 (2.401)			9.644 (1.566)			6.360 (2.932)			5.843 (2.312)		
Adjusted R square	0.440			0.284			0.266			0.321		

* $p < 0.05$, **, $p < 0.01$, ***$p < 0.005$
[a] = Sig. 0.000***, dependent factor: Science Park talent attraction activities.
[b] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.
[c] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.
[d] = Sig. 0.000***, dependent factor: Informal and formal partnerships with students and firm/university.

Moreover, in terms of the R-square adjusted scores, there are differences in models 1–4. In model 1, the adjusted R-square is 0.44. The R-square of 1.0 indicates a perfect fit of a regression line's approximation of real data points and, consequently, Models 1 and 4 (Adjusted R square: 0.321) show a better fit than model 2 and 3 (Adjusted R squares: 0.284 and 0.266, respectively). It is, however, difficult to directly compare several regressions this way unless the same independent variables are used. Adding a new independent variable typically improves the R-square, but this addition is an optimization that may reduce the contribution of another variable.

According to the correlation matrix (Table 3), there is only one relationship among the four control variables and the latent dependent variable, the control variable *Science Park age* that is negatively associated with *Informal and formal partnerships with students and firms/universities*. If we include the control variable *Science Park age* in model 4, the control variable is negatively significant at the 0.05 level (0.017), and the adjusted R square is 0.378. The model is significant at the 0.001 level, and the only significant factor is the mediating variable.

We conduct a test for collinearity to check the findings further because highly collinear- or linear-related variables can cause problems with regression coefficient estimates. Multicollinearity is a statistical problem that occurs in regression analysis when there is a high correlation between at least one independent variable and a combination of the other independent variables (see the correlation matrix in Table 3 and Table A2). A VIF greater than five is generally considered evidence of multicollinearity, and a tolerance below 0.20 a cause for concern. We could not find any indication of multicollinearity in the statistical analysis (See Table 4).

5. Discussion and implications

This study contributes to the literature concerned with how talented people at universities can lay the foundation for the future performance of local firms. These implications are important for policymakers and Science Park managers who select and support local firms based on their business and innovation dimensions and support a firm´s development through the Science Park. Talent, in the form of graduate students, should be attracted to the Science Park for future development and performance. The proximity to universities and incubators and Science Park status and recruitment are also important factors in business location attraction (Löfsten, 2016). However, over the years, several researchers have questioned policies encouraging the clustering of firms as not being in the best interest of the regional economy (Bezdek, 1975; Galbraith, 1985: Lai, Hsu, Lin, Chen, & Lin, 2014). Hu (2006) found that spatial proximity of firms clustering within the Hsinchu and Tainan Science-based Industrial Park increases the interaction among high-tech personnel and the expansion of professional networks. Jonsson (2002) found that proximity is important; however, not for all firms, to different degrees and for a variety of reasons.

The main finding in this study is that we provide evidence that supports *Science Park talent attraction activities* as a mediating variable, enabling Science Parks to combine *Involving tenant firms/students and attracting former students* (alumni) and *Dimensions for students to remain in the Science Park after graduation* with *Informal and formal partnerships with students and firms/universities*. Our finding is particularly important in the sense that the Science Park management can use this evidence to develop actions that support the talent management activities of tenant firms, thereby enticing prominent firms and foreign talent to the Science Park through events and networking activities. One of the main objectives of Science Parks is to provide a sort of catalytic 'incubator environment' to transform science at universities into commercial innovations (Deeds, Decarolis, & Coombs, 2000; Moon, Mariadoss, & Johnson, 2019). Accordingly, it is desirable that the location of the Science Park is close to universities or academic research institutes. As such, the formal relationships can include patents, licensing, and cooperative alliances while the informal ones can include the mobility of scientists and engineers, social meetings, and discussions (Deeds et al., 2000; Pouder & St John, 1996).

Many studies in the area of talent management underpin the resource-based theory, which states that a firm´s specific competencies build its competitive advantage through the adaptation of human resource systems (Lado & Wilson, 1994). Several studies, relevant to the resource-based theory (Barney, 1991; Barney & Wright, 1998), provide results investigating human resources in the context of a firm's strategy to gain a competitive advantage. However, due to a lack of similarity in definition and theoretical framework, talent management gathers perspectives and practices from several fields such as human resource management, resource-based theory, and capabilities (Sparrow, Scullion, & Tarique, 2014). Competitive advantage can, hence, be obtained from talent management practices, which include attracting, developing, and retaining talent (Heinen & O'Neill, 2004). To gain a competitive advantage, first Science Parks need to increase their productivity by recruiting the right people to the park management team and assessing the relevant competencies based on the strategic goals of the park.

The talent attraction process starts with identifying talented people by assessing their potential and performance (Ross, 2013). Once the best people are identified and attracted, the challenge is to make it easier for companies to recruit and develop them, increasing company performance. Although many firms ensure excellent development opportunities, it is difficult to sustain this commitment over the long term (Younger, Smallwood, Group, & Ulrich, 2007). Developing talent should not be concentrated solely on skills for job performance.

At the process level, Science Park managers should encourage the development of social meetings, which are informal face-to-face meetings, as well as time spent discussing suggestions and ideas (personal interaction) with other people in the same business. By attracting students, tenant firms can have a positive impact on their performance as well as Science Park development. As the creation of an innovative environment and the development of opportunities for students result (at least partly) from the efforts of Science Park management, talent attraction activities also result (at least partly) from active management.

As in most research, this study has limitations, which offer avenues for future research. For example, researchers should investigate the relationship between Science Park talent attraction activities and informal and formal partnerships with students and firms/universities across a broader range of parks and settings. The survey data in this study captures only a single year. Future research could explore the multidimensionality of the interaction processes and capture them over a more extended period. Longitudinal qualitative studies can be conducted to allow a better understanding of the interplay between the independent and dependent factors. These processes evolve through a process of interaction, which this study could not capture. Thus, future research could explore changes in the mediating variable over time.

The government and local authorities play a role in demanding some directions in the orientation of the Science Parks and the lack of accuracy regarding the objectives and goals of Science Parks limits the possibility to evaluate and compare the parks. Previous research has been criticised for being disintegrated with a narrow focus on human resource activities and an analysis that considers human resources as a system is still unusual in the research literature. However, there are several general problems in defining talent and making the right business decisions depend on owned talent and the efficiency of their competencies which is difficult to measure. Talent must also include the drive to perform and be motivated at a high level.

6. Conclusions

This paper investigates European and Brazilian Science Parks to expand the understanding of talent attraction management in the context of innovation, human resource management, and strategic management. The analysis investigates how the mediating variable, Science Park talent attraction activities of the Science Park management, affects the Informal and formal partnerships between students and firms/universities. The analysis is based on a sample of 59 Science Parks and results in a model that includes four significant factors. These findings offer opportunities for Science Parks' management to analyse how the links between Science Parks and universities can be supported. Specifically, we identify how the management team can contribute to successful relationships among university, students/alumni, other academia, and firms to further develop the Science Parks.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendix

Table A1. Factor analysis: Principal axis factoring with Varimax rotation (rotated factor matrix) [abc].

Variables	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5 [d]	Factor 6 [d]
Factor names	Involving tenant firms/students and attraction of former students (alumni)	Dimensions for the students to remain in the park after graduation	Informal and formal partnerships with students and firms/university	Science Park talent attraction activities		
Cronbach α	$\alpha = 0.818$	$\alpha = 0.814$	$\alpha = 0.822$	$\alpha = 0.784$		
Variable						
1.	0.039	0.220	**0.659**	0.370	0.187	-.0.056
2.	0.160	0.248	**0.808**	0.168	0.033	−0.159
3.	0.320	0.135	**0.543**	0.089	−0.166	0.233
4.	0.169	0.133	0.222	**0.522**	0.411	−0.099
5.	**0.717**	0.004	0.147	0.058	−0.178	-.0.01
6.	**0.656**	0.093	−0.063	0.335	0.129	−0.282
7.	−0.043	**0.506**	0.266	0.367	0.218	−0.014
8.	**0.710**	0.072	0.084	0.108	0.341	−0.062
9.	0.362	0.111	0.430	0.133	**0.541**	0.045
10.	0.086	0.150	**0.726**	0.047	0.145	0.048
11.	**0.439**	0.153	0.254	0.141	0.049	−0.584
12.	0.481	0.087	0.049	**0.641**	0.082	−0.097
13.	**0.746**	0.022	0.267	0.155	0.115	0.197
14.	0.338	0.268	0.297	**0.615**	−0.013	0.202
15.	0.129	0.337	0.442	**0.535**	−0.174	0.059
16.	0.063	0.266	0.100	0.049	0.031	**0.408**
17.	0.061	**0.657**	0.199	0.039	−0.334	0.152
18.	0.059	**0.764**	0.162	0.086	−0.166	−0.049
19.	0.027	**0.498**	0.224	0.235	0.086	−0.096
20.	0.004	**0.696**	0.186	0.056	0.306	0.122
21.	0.172	**0.621**	−0.049	0.119	0.335	0.181

Notes: [a] = Cumulative variance 59.826%.
[b] = (Cronbach α) > 0.500.
[c] = KMO = 0.668 and Bartlett's test of sphericity = 0.000.
[d] = Only one variable. It will be excluded from further analysis.

Table A2. Correlation matrix on the variable level between the 25 variables in the study (SP = Science Park).

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
1. The man – between students and firms in the SP																								
2. The man – between faculty and firms in the SP	.751*																							
3. The man team provides services to promote	.416*	.485**																						
4. The man team develops specific activities to	.531**	.368**	.103																					
5. The man team is directly or partially involved	.107	.240	.317*																					
6. The man team offers services and facilities for	.179	.246	.108	.382**	.457**																			
7. Attracting prominent firms to the SP is an	.415**	.345**	.198	.382**	-.008	.163																		
8. The man team count on university student coll	.232	.232	.200	.322*	.490**	.639**	.145																	
9. The man team cooperates with student organis	.418**	.418**	.315*	.477**	.244	.216	.354**	.540**																
10. The man team develops activities to promote	.504**	.659**	.411**	.245	.135	.074	.386**	.165	.477**															
11. The man team develops activities to attract	.285*	.389**	.124	.257*	.361**	.462**	.236	.435**	.348**	.287*														
12. The man team works to create a positive flow	.299*	.273*	.214	.494**	.317*	.603**	.271*	.382**	.326*	.146	.424**													
13. The man team promotes activities to reach out	.263*	.337**	.517**	.326*	.571**	.476**	.080	.522**	.481**	.276*	.316*	.529**												
14. Influencing students to remain in the park after	.511**	.423**	.437**	.355**	.322*	.385**	.439**	.359**	.384**	.265*	.227	.597**	.455**											
15. The events and activities promoted by the man	.495**	.495**	.408**	.414**	.257*	.170	.506**	.190	.290*	.422**	.274*	.400**	.248	.626**										
16. Support and encouragem to start a new busin	.141	.097	.052	.090	.102	-.066	.171	.170	.080	.257*	-.167	.035	.138	.269*	.184									
17. Opportun to work in an innovative environ	.182	.327*	.316*	.002	.093	.084	.321*	-.043	-.002	.271*	.115	.138	.074	.236	.447**	-.113								
18. Opportun to work with excellent professionals	.341**	.341**	.250	.162	.175	.042	.408**	.077	.112	.108	.207	.094	.102	.324*	.428**	-.021	.134							
19. Opportun to work in prominent firms	.322*	.358**	.207	.292*	.058	.159	.393**	.103	.224	.256*	.265*	.240	.130	.392**	.353**	-.146	.214	-.009						
20. Better opportunities to find a job	.369**	.369**	.187	.228	-.083	.122	.465**	.153	.300*	.278*	.064	.124	.205	.371**	.184	-.210	.151	.028	.090					

(*Continued*)

Table A2. Continued.

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.
21. Qual of life, e.g. parks and soc meeting places	.204	.134	.130	.318*	.058	.208	.447**	.264**	.354**	.118	.082	.246	.227.	.237	.257*	-.140	.035	-.172	.155	.257*				
Control variables																								
22. Science Park – age	-.204	-.218	.281*	-.167	.040	-.008	-.104	-.089	-.243	-.310*	-.019	.110	-.057	.002	-.098	-.163	-.113	-.021	-.146	-.210	-.140			
23. Science Park – number of firms	.135	.006	.061	.127	-.151	.119	.166	-.007	-.162	.055	.056	.108	-.087	.090	.131	-.082	.004	.1234	.214	.152	.035	.328*		
24. Science Park – park management	.022	-.004	-.012	-.307*	-.215	-.170	.051	-.393**	-.283*	.004	-.352**	-.293*	-.455**	-.070	-.114	-.104	.027	.095	-.009	.028	-.172	.070	.127	
25. Science Park – total number of employees	.102	-.025	.108	.131	-.087	.218	.114	.059	.033	-.014	.062	.175	-.051	.121	-.009	-.143	-.070	.090	.112	.090	.155	.036	.539**	.065

Notes * = Correlation is significant (0.05-level), 2-tailed,** = Correlation is significant (0.01-level), 2-tailed.

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