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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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