How To Bring the Work of a Science Park to Its Territory

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Abstract: Science parks have become useful instruments in transferring knowledge from universities to the industry. On the other hand, some studies have affirmed that technology transfer activities and results can be encouraged by geographical proximity between companies and university premises and people. If this is true, it would be useful to set up science park satellite sites near selected geographical areas. A few science parks have actually done this. However, research in this field is scarce and anecdotic.

We qualitatively explored this field, using the case of the University of Valencia's Science Park. Our work provides and tests a methodology to help with the decision to set up a science park satellite site, consisting of three questions: why, what and how. Our work also highlights some key issues related to the viability of this kind of decision, and opens up interesting avenues for future research in the field of university-industry collaboration.

Keywords: science park; university-industry interaction; knowledge transfer; technology transfer; regional development

Cómo llevar la labor de un parque científico a su territorio

Resumen: Los parques científicos se han mostrado como instrumentos útiles a la hora de transferir el conocimiento de las universidades a la industria. Por otro lado, algunos estudios afirman que las actividades para transferir tecnología y sus resultados pueden ser estimulados por la proximidad geográfica entre las instalaciones y personal de empresas y universidad. Si esto fuera cierto, sería útil establecer sedes filiales de los parques científicos en determinadas áreas geográficas. Unos pocos parques científicos lo han hecho. No obstante, la investigación en este campo es escasa y anecdótica.

Este artículo explora este campo de manera cualitativa, usando el caso del Parque Científico de la Universidad de Valencia. Nuestro trabajo aporta y chequea una metodología para ayudar en la toma de las decisiones sobre el establecimiento de sedes filiales de parques científicos, consistente en tres preguntas: para qué, qué y cómo. Nuestro trabajo hace aflorar también algunas cuestiones clave sobre la viabilidad de este tipo de decisiones, y abre nuevas e interesantes vías de investigación en el ámbito de la colaboración universidad-empresa.

Palabras clave*:* parque científico; colaboración universidad empresa; transferencia de conocimiento; transferencia de tecnolog*ía*; desarrollo regional

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1. Introduction

During the last quarter of the 20th century, universities underwent a transformative process (some more intensively than others), with some authors talking about a revolution in this sense (Martin & Etzkowitz, 2000). This process began when universities took on a new third mission, on top of their two traditional ones: creating knowledge (research) and transmitting knowledge (teaching). This third mission can be described as their contribution to the economic and social development of their environment.

However, taking on the third mission has often not been the result of a process of conviction, but instead the answer to external changes which have threatened universities' survival. An example of this is the university budget cut made by Margaret Thatcher's government in 1981 which explains the change that took place in some British universities. Either by conviction or out of necessity, some universities began to undertake more proactive roles (i.e., to market the knowledge they generated, or to create companies that harnessed this knowledge), which aimed to contribute to the economic development of their environment and generate additional income that would balance their budgets. Thus, the entrepreneurial university was born (Clark, 1998).

In doing so, universities began to take on roles previously reserved for industry. At the same time, industry became involved in the creation of knowledge. This role exchange inspired the so-called *Triple helix model,* which aimed to show how, in this new context, universities, industry and public institutions collaborated and interchanged their roles to promote socio-economic development, maximising possible synergies, against this new background. Although this collaboration has been studied in many research papers, some aspects of it remain unexplored, as recent reviews have revealed (Skute, Zalewska-Kurek, Hatak, & de Weerd-Nederhof, 2019). The focus of our research adds a new perspective to the exploration of the issue.

In addition, new forms of university-industry collaboration (i.e., spin-out companies) were added to traditional ones (i.e., technology

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licencing agreements). Both universities and industry created powerful instruments to boost collaboration, including certain types of agencies and associations on the industry side, and technology transfer offices, incubators and science parks on the university side, and the creation of these new knowledge-intensive spaces has contributed to regional economic development (Guerrero, Cunningham, & Urbano, 2015).

Science parks have traditionally been set up near their owner universities' main sites. Only a few have created satellite sites, seeking collaboration with industry and other organisations in locations which are further away yet still come under their area of influence. A decision such as the creation of a subsidiary site triggers a significant number of related questions: why? (What are the specific goals to be achieved? Are they aligned with all the relevant stakeholders' missions?), where? (Does the region have the potential to benefit from the initiative?), what? (What services should be included or decentralised?) and how? (Which staff should be hired or moved from the Park's headquarters? What spaces and equipment should the satellite site include?). A science park satellite site settlement is a relevant investment that universities need to define internally. There is no scientific literature studying the why or how to make a decision of this magnitude.

To fill this gap, we began reviewing the existing literature in different related fields, and specifically the area related to university-industry collaboration. Then, we proposed a methodological framework to analyse why and how to bring the work of a science park to its territory, and we applied this methodology to a specific case, the plan put forward by the University of Valencia's Science Park (PCUV, Parc Científic de la Universitat de València) to set up satellite offices in two different geographical areas of the Valencian Region, in Spain. We close the article with the results of our study and our conclusions.

2. Literature review

2.1. University-industry collaboration under the third mission perspective

New knowledge is understood to be a major driver of economic growth, and universities (accomplishing their first mission) are important sources of new knowledge (Agrawal, 2001). However, it is industry which materialises this economic growth, adding new knowledge to their products and processes. Consequently, transferring new knowledge from universities to industry is a logical way to fulfil this third mission.

Patenting and licencing new technologies, and knowledge in general, was seen to be a primary channel for knowledge transfer, guided by the logic that universities and government labs make and industry takes (Bozeman, 2000). However, the role of this channel has been modest and limited to a few industrial sectors (Agrawal, 2001), whereas other channels, like publications, consultancy, open meetings and conferences, were considered to be more important. In any case, these channels were only effective in transferring a small part of the knowledge created by universities and other research centres, partly because incumbent firms use new knowledge to improve their products and processes (exploitation) but are not as good at introducing disruptive innovation. In fact, radical innovation mainly comes from new firm start-ups (Acs, Braunerhjelm, Audretsch, & Carlsson, 2009). Consequently, universities had to generate new instruments to promote and support the creation and growth of start-ups, such as incubators. Additionally, the innovation process was less linear than it appeared, with interaction between universities and industry being necessary during the first stages of the innovation process (Colyvas et al., 2002).

Ankrah *et al.* (2015) identified six organisational forms of university-industry collaboration, thus broadening earlier works (D'Este, Patel, D'Este, & Patel, 2007): (1) personal informal relationships (academic spin-outs, individual consultancy, conferences, etc.), (2) personal formal relationships (students' involvement in industrial projects, use of university or industry facilities, etc.), (3) 'third party' cooperation (institutional consultancy, technological brokerage companies or associations, liaison offices, etc.), (4) formal targeted agreements (contract research, patenting and licencing agreements, equity holdings in spin-outs, etc.), (5) formal non-targeted agreements (broad agreements for university-industry collaborations, industry-sponsored R&D, research grants, etc.), and (6) focused structures (association contracts, incubation centres and science parks, etc.).

A recent systematic review of literature on university-industry collaboration identified several significant differences between developed and developing countries, regarding the presence of channels of interaction and the factors affecting the variety and use of these channels, as well as the channels preferred by the people involved (Nsanzumuhire & Groot, 2020).

2.2. The effectiveness of university-industry collaboration activities

Five broad dimensions determine the effectiveness of technology transfer activities: (1) characteristics of the transfer agent, (2) characteristics of the transfer media (channel), (3) characteristics of the transfer object, (4) the demand environment and (5) characteristics of the transfer recipient (Bozeman, 2000). Vick and Robertson (2018) pointed to four key issues in university-industry collaboration: channels, motivational drivers, obstacles to collaboration and outcomes.

In terms of motivation, a wide variety of stakeholders are involved in cooperation. Their interaction drives business model evolution in collaboration channels. Institutional goals are relevant but so are individual attitudes and behaviours (D'Este et al., 2007). Additionally, collaboration is full of obstacles, due to the misalignment of incentives, rules and procedures between universities and industry (Vick & Robertson, 2018), a lack of understanding (Hall, Link, & Scott, 2001), and the specific nature of the scientific competence available in research centres (Bigliardi, Dormio, Nosella, & Petroni, 2006). Consequently, trust formation and boundary spanning activities and mechanisms are crucial (Nsanzumuhire & Groot, 2020).

On the other hand, it is difficult to measure the outcomes of collaborative processes, particularly at societal level, because public value is an elusive criterion, but also because knowledge demand from industry and knowledge supply by universities have not been properly linked yet (Vick & Robertson, 2018). Additionally, some of the benefits for both universities and industry are not explicit, and the search for tangible outcomes may be looking in the wrong place (Ankrah et al., 2015). In fact, knowledge spillovers seem to be an important, though difficult to measure, benefit of collaboration (Díez-Vial & Fernández-Olmos, 2015). We address this issue below.

2.3. University instruments supporting collaboration

Both universities and industry have progressively created different formal instruments to promote and support collaboration and knowledge transfer between them. To accomplish this goal, intermediaries perform a long list of functions, including foresight and diagnosis, scanning and information processing, knowledge processing and combination/recombination, gatekeeping and brokering, testing and validation, accreditation, validation and regulation, protecting results, commercialisation and the evaluation of outcomes. Although the activities carried out by these instruments overlap considerably (Good, Knockaert, Soppe, & Wright, 2019), they have reached a certain degree of specialisation.

Technology Transfer Offices (TTOs) were universities' first formal intermediaries. They initially focused on protecting research results and licencing them. More recently, they have added a third main activity: setting up companies around their research results.

Incubators support the formation and development of technology-based start-up companies and they have contributed to regional economic growth for decades (McAdam, Miller, & McAdam, 2016). Pioneering incubators initially focused on real estate supply and shared administrative services, but they soon evolved to create a collaborative environment for tenants, based on peer support and network resources (Bøllingtoft & Ulhøi, 2005).

Science parks emerged with a wider perspective, often including incubating tasks, but not limiting this to start-up companies. Science parks open up their space to incumbent firms and to their R&D departments, seeking a greater degree of collaboration between these companies and the university's research departments and laboratories. This also promotes other collaboration channels (i.e., research contracts), attracting other actors such as business service providers and so maximising synergic effects (Good et al., 2019).

2.4. Science parks and their roles

The creation of science parks is usually supported by local governments and involves other institutions on the industry side (i.e., chambers of commerce, professional associations, financial institutions, etc.). According to Bigliardi *et al*. (2006, p. 492) "it seems to be essential to identify the real mission and the resulting strategy of the science park".

In keeping with Bøllingtoft and Ulhøi (2005) and other authors, science parks' services can be categorised into the following groups: (1) high value real-estate services, (2) on-demand services (reception, communications, cafeteria, etc.), (3) access to research-related and other university equipment and services, (4) management support, and (5) networking services.

Firms can benefit from setting up in a science park, and particularly those with inferior in-house R&D capabilities. However, the intensity of the relationship between on-park firms and university research centres is highly variable, probably because maintaining formal and informal interactions requires time and effort (Díez-Vial & Fernández-Olmos, 2015).

In a recent review, Good *et al*. (2019) summarised science park activities as follows: attracting technology-based start-ups, corporations, public research groups and relevant service providers; screening potential residents; enforcing graduation polices related to how long companies stay on the park; planning networking events; building formal and informal links with the university; building external networks; providing office space and access to basic administrative resources; offering business and financial support services; and engaging with and balancing the needs of external stakeholders.

The abilities that people require in science parks are particularly important: the ability to recognise and attract high-potential residents, the ability to develop and manage relationships with a range of relevant stakeholders, the ability to build networks, and have relevant industry background as well as business and mentoring experience (Good et al., 2019).

Bigliardi *et al*. (2006) found that the evaluation criteria of science parks' performance "should be aligned with science parks' (a) actual mission, (b) major stakeholders' commitment, (c) economic regional conditions, (d) legal forms, (e) nature of the scientific competence base available within research centres and (f) SP's life-cycle stages" (Bigliardi *et al*., 2006, p. 489).

2.5. Entrepreneurship

Entrepreneurship has been recognised as a driver of economic growth since the times of Schumpeter. In fact, new firms contribute significantly to regional employment growth (OECD, 2017). The evolution towards a knowledge economy, and the rapid development of information and communication technologies, have given an increasingly important role to entrepreneurship. Carayannis and Campbell (2009) added a fourth helix to Etzkowitz and Leydersdorff's Triple helix model, which they identified as a 'media-based and culture-based public', that includes media, creative firms, culture, values, life styles, art and perhaps also the notion of 'creative class' as coined by Florida (2004), which is something that seems to match the entrepreneurial world. However, the entrepreneurial paradigm has changed dramatically over the last two decades. Business opportunity is now created, instead of discovered (Alvarez & Barney, 2007), under an effectual logic that makes the entrepreneurial project evolve (Sarasvathy, 2008). In this new entrepreneurial process, the search for partners becomes crucial and, consequently, tools such as networking and partnerships with knowledge owners are essential (Bøllingtoft & Ulhøi, 2005).

Entrepreneurship is not a common feature among individuals. Only one in five individuals in the world show entrepreneurial intentions (GEM, 2017). It is even less common among academic staff, if we define entrepreneurship in the same terms as the Global Entrepreneurship Monitor. In a survey of 22,556 UK academics, Abreu and Grinevich (2013) found that only a 3.5% had been involved in spin-out companies. This is a relevant constraint, and reinforces the idea that "the characteristics of the individual researcher have a much stronger impact in explaining the variety of interactions" (D'Este *et al.*, 2007, p. 1306).

2.6. Impact on regional development and the relevance of geography

Firms located in incubators and science parks, as well as others situated around them, generally benefit from this location (Link & Scott, 2018). Prestige, formal relationships with universities (Díez-Vial & Fernández-Olmos, 2015), informal and human resource links (Vedovello, 1997) and reduced costs for research inputs (Link & Scott, 2018) are the primary advantages. As a result, these firms can grow more than other firms that do not benefit from these effects (Bøllingtoft, 2012).

Geographical proximity increases knowledge spillovers, technology transfer and innovation (Link & Scott, 2018), because of the tacit and sticky nature of knowledge. In fact, the tacit knowledge debate has shifted the spatial focus from national level to regional level. Nevertheless, collaboration between firms in science parks and university research centres is not homogeneous, partially because of the irregular distribution of firms' absorptive capacity. It also differs from one sector to another.

Knowledge spillovers are also driven by entrepreneurial activities (Acs et al., 2009), particularly in a context of opportunity creation processes under effectual logic. Nevertheless, other forms of proximity such as cognitive, organisational, social and institutional proximity may act as a substitute for geographical proximity (Boschma, 2005). Interestingly, distance in one dimension can be compensated by proximity in at least one other direction (Huber, 2012), and geographical proximity facilitates other forms of proximity (Balland, Boschma, & Frenken, 2015). For instance, the exchange of tacit knowledge via spatial proximity is fundamental for improving cognitive proximity (Villani, Rasmussen, & Grimaldi, 2017).

All in all, today we have significant evidence of the positive outcomes that the research and business activities of entrepreneurial universities have on regional economic development (Guerrero et al., 2015), although these effects are mediated by several operational factors, such as motivation, available resources and the capabilities of the agents involved (Villasalero, 2014).

2.7. Science parks going to its territory

Dispersal of universities across several sites may contribute to new economic activities (Benneworth, Charles, & Madanipour, 2010). In fact, many universities maintain different sites, although this seems to be more closely related to universities second mission (teaching), aiming to cater for students who live far away from the main university site.

Some science parks have also established different sites throughout their regions. As far as we know, little research has focused on this kind of initiatives, and on the why and the how of these decisions, though they are expensive ones. The scarce studies carried out shows that these decentralised facilities are mainly incubators.

Warwick Science Park (WSP) is a paradigmatic example. It was created in 1984 by a well-known entrepreneurial university, the University of Warwick, in a region of the UK which today has less than 600,000 inhabitants. In 1995, an item on the WSP Director's agenda was the creation of satellite parks in other parts of the region, looking for new opportunities and linkages (Clark, 1998). WSP's satellite parks materialised in 1997, 2000 and 2001, respectively, with the satellite sites being tenured by ad-hoc joint ventures and management contracts (EU, 2013). WSP's website explains that all the premises include incubator space and offer business support, although this is catered for by a sole expert team based at the main site.

2.8. Literature review conclusion

Our literature review shows some issues that have to be considered when bringing a science park to its territory through the creation of satellite parks or similar initiatives. A useful perspective is provided by the innovation value chain (IVC) model, which frames the IVC in three links: (1) firm's knowledge sourcing activity, (2) the process of knowledge transformation, and (3) knowledge exploitation. Roper, Du and Love (2008) identified five different types of knowledge sourcing activity: (1) in-house R&D, (2) forward linkages to customers, (3) backward links to either suppliers or external consultants, (4) horizontal linkages to either competitors or through joint ventures, and (5) linkages to universities and other public research centres. The complementarities between these sources are relevant and the geographical proximity of all these actors can trigger them.

However, further research is required on a great deal of related fields, such as the motivations for engaging in knowledge transfer between universities and industry (Ankrah et al., 2015), the role of internal and external intermediaries in knowledge transfer processes (Vick & Robertson, 2018), the regional contingencies under which incubators and science parks contribute to the region (Lecluyse, Knockaert, & Spithoven, 2019) and, especially, the adaptation of the knowledge transfer ecosystem to the local context (Good et al., 2019). We aimed to contribute to these fields answering our research question (How to bring the work of a science park to its territory?), under the managerial and strategic perspective recommended by Baraldi and Ingemansson Havenvid (2016) and Good *et al.* (2019).

3. A procedural framework for answering why, what and how a science park satellite office can be set up

University-industry collaboration, as well as entrepreneurship based on new knowledge, can contribute to the economic development of a region. A satellite office of a science park, if set up in the region, can trigger or drive this collaboration, though this represents significant investment and major challenges. Its success requires the fulfilment of two conditions, namely (1) a certain breeding ground has to exist, and (2) the initiative must be properly implemented. In addition, prior analysis as to its viability is required, and this analysis has to be able to support a credible plan.

To forecast and guarantee the initiative's profitability, we propose an analysis focused on providing in-depth answers to three questions: why make this investment, what should be offered and how should this portfolio be built. These questions have been proposed largely by research on management as a guide for decision-making. Hamel (2006), for instance, explored decisions on management innovation asking the why, what and how, and more recently, Siegel & Wright (2015) described the evolution of academic entrepreneurship asking why, what, who and how. In this study, the question of who has been omitted because the initiative comes from a defined actor, i.e., the science park.

3.1. Why set up a science park satellite office in a region?

Given that a certain breeding ground in the regional industry is needed, in the shape of innovative companies and entrepreneurial managers, any analysis must verify the existence of a certain critical mass of innovative companies, as well as their size and sectors, given that these features are related to their capacity to invest in R&D and innovation, as well as to their propensity to collaborate with universities and other public research organisations (Sjöö & Hellström, 2019). In general, are they involved in R&D projects? Do they have instruments (department, staff) working on R&D and innovation tasks? Industrial associations can be another relevant industrial partner and clustering can also be a good indicator.

On the other hand, universities must also be willing to set a satellite office up. Are researchers ready to take advantage of the efforts made by the science park? Their predisposition and drivers must be analysed. Which other university actors are involved? What is the specific mission of the science park? What are the motivations and background of its management team?

Regional governments can also be involved. Are they ready to support the initiative? What kind of support can they give? What kind of instruments do they have in place?

And finally, what about the rest of the people in the region. Are they particularly entrepreneurial? What background does the region have in this area?

Additionally, another challenging question centres on whether the motivations of the different stakeholders are aligned? Which other cultural and behavioural barriers are involved?

3.2. What should the satellite office offer?

Science parks provide diverse services at their headquarters. Which ones should be offered by the satellite office? Are there other specifically demanded services at regional level? Two kinds of selection criteria should be considered here: the effectiveness criterion and the efficiency criterion.

The effectiveness criterion recommends discriminating according to the type of companies. To attract start-ups, science parks' satellite offices need to make networking efforts and should also offer attractive incubation spaces together with support services, such as business processes mentoring. On the other hand, science park satellite offices also need to make networking efforts to engage with incumbent companies in the territory but, in this case, they need to show how these companies can benefit from the university's knowledge, technology research equipment, advanced services, etc.

The efficiency criterion recommends only offering those services that can reach a certain critical mass in the satellite office. Other services can be offered on-line or from the science park headquarters, particularly those that involve specialised staff and the use of complex equipment.

3.3. How should the satellite office portfolio be built?

A service-dominant logic perspective is helpful in addressing this component (Ribeiro, Higuchi, Bronzo, Veiga, & De Faria, 2016). Both effectiveness and efficiency criteria are again relevant. The effectiveness criterion recommends equipping the science park's satellite office with qualified staff, high-value spaces and powerful equipment, thus placing these resources close to the territory. However, some issues emerge, including the difficulty of finding local candidates to fill these positions. Another option is to bring in this kind of human resources from outside, but this can be costly. This issue introduces the relevance of the second criterion, efficiency. Qualified staff and very specialised equipment may be underused if they are only employed in the satellite office. Consequently, answering the how question requires a precise answer to the why question. How to build the service portfolio depends on the motivation and potential of the stakeholders. In fact, a strong, collective partnership between all the regional players involved in the spillover and innovative processes is essential (Corsi & Prencipe, 2016).

4. Methodological approach and data

Forecasting the viability of a science park satellite office requires a large volume of information. Most of this information is specific to both the science park under study and its context. Nevertheless, a first approach could be made via public sources (regional websites and other Internet resources), such as the main features of regional industry (i.e., clustering, industry associations and their R&D initiatives, most active companies in this area, etc.), main regional governmental instruments and their initiatives, etc.

For more detailed evidence, primary sources of information are required. For example, the real motivations of the different stakeholders will only emerge from in-depth interviews with key people (managers, technical staff, researchers, etc.). Additionally, the use of this information requires a process of interpretation (Pacagnella Júnior, Porto, Pacífico, & Salgado Júnior, 2015). However, when the target of inquiries is dispersed and hard to reach, indirect information, estimators and similar resources have to be used.

In order to check our framework, we put together a qualitative study, based on the case of a science park that was in the process of studying whether to set up a couple of satellite offices. Several authors have developed analogous qualitative studies to answer other research questions in the same field. Of these, Vedovello (1997) studied geographical proximity as a driving force of university-industry interaction through a case study of a single British science park and Baraldi and Ingemansson Havenvid (2016) identified new dimensions of business incubation through an in-depth case study of the incubator related to the Swedish medical university Karolinska Institute.

5. Our case: the University of Valencia's Science Park

The University of Valencia's Science Park was established in 2009 and its management was commissioned to a Foundation made up of the University of Valencia (UV) itself, the Valencia Chamber of Commerce, the Valencian Business Confederation and two financial companies. The objectives of this Foundation are: (1) to promote technological development, knowledge transfer and industrial innovation, (2) to encourage research of social relevance at regional, national and international levels, (3) to establish co-operation between research groups in the UV and companies, (4) to create innovative companies that facilitate alliances with strategic partners, (5) to promote the transfer and dissemination of university research results and (6) to make companies more competitive and boost the economic development of the Valencian Region.

At the end of 2020, 88 innovative companies At the end of 2020, 88 innovative companies had their offices or R&D facilities in the Science Park's main site, located in the metropolitan area of Valencia, the region's main city. 35% of these companies spent over 50% of their budget on R&D and innovation (FPCUV, 2020).

In 2020, the management of the University of Valencia's Science Park Foundation asked itself whether the Park could achieve more setting up satellite offices in different areas of the Valencian Region. They also asked themselves what these satellite offices should do and how they should do it. The choice of this Science Park was, consequently, a matter of opportunity.

Two geographical areas were proposed: La Safor, a coastal area with Gandia as its main city, and La Vall d'Albaida, with Ontinyent as its main city. Table 1 summarised the main data obtained from secondary sources for each of the regions.

Table 1. Regional information

	La Safor	La Vall d'Albaida
Basic information	430 sqm 170,686 inhabitants 31 villages, towns, cities	722 sqm 87,532 inhabitants 34 villages, towns, cities
Main city and basic data	Gandia 73,829 inhabitants 72 km from Valencia	Ontinyent 35,395 inhabitants 86 km from Valencia
Main economic sectors	Tourism, building and retail	Retail, manufacture of plastic and rubber products and textile cluster (depleted after the 2005 sectorial crisis)
Number of companies	10,987 (total) 70 (with revenue over €10 M) 8 of these engage in R&D or innovation activities	6,541 (total) 46 (with revenue over €10 M) 13 of these engage in R&D or innovation activities
Main public initiatives and their focus	*Urbalab*: digital transformation, entrepreneurship, social innovation, professional training in new technologies	*Soterrani de les idees*: entrepreneurship, coworking space
Focus of the main industry associations	Entrepreneurship, networking and consultancy on new technologies	Innovation, sustainability, internationalisation, new materials, new technologies, textile industry
Presence of the University of Valencia in the region	A minor summer university	Four undergraduate degrees: management, nursing, primary school teaching, and sport sciences

Table 2 lists the interviews conducted with key people from the University of Valencia (five people), people from its territory (four people in managerial and technical positions) and with the Science Park management team (three members of staff). The interviewees were chosen to capture the different perspectives, including all the key stakeholders suggested by the literature review (Ribeiro et al., 2016). The specific list, in the case of the key people from the University, was configured according to the suggestions made by the Science Park management team. In the case of the territory, the list was suggested based on the initial research using public sources.

Finally, the choice of the Science Park interviewees tried to take different positions on board. The list grew progressively until it reached saturation point in each of the three categories (Glaser & Strauss, 1967). The interviews followed a semi-structured script, and their duration partially shows the interviewee's interest in the topic.

Table 2. Interview details

Institution category	Main field or scope	Interviewee's position	Interview duration
Research Institute	Scientific materials	Former Director	1h. 47'
Research Institute	IT and robotics	Director	30'
Research Institute	Social sciences	Director	15'
Research Institute	Social sciences	Director	1h.
Research Institute	Social sciences	Director	45'
Industry association	La Safor	Innovation Agent	1h.
City Hall	La Safor (Gandía)	Local Development Agent	25'
Industry association	La Vall d'Albaida	Chair	40'
Industry association	La Vall d'Albaida	Innovation Agent	30'
Science Park team		General Manager	37'
Science Park team		Operation Manager	45'
Science Park team		Technology Transfer Agent	1h.35'

6. Discussion and results

6.1.Why?

We applied our framework to explore the main stakeholders' commitment to knowledge transfer activities that could boost the work of satellite sites.

The willingness to undertake knowledge transfer activities varied in the different University's research units. Some of them were extremely motivated while others did not even take them into consideration.

Analogous variability was observed within each research unit. Some researchers were highly motivated to undertake knowledge transfer activities while others ignored them and even discouraged them. The hierarchical level of the people in the research was also relevant. One member of the Science Park team explained a significant case that took place in a research unit. A researcher had obtained public funding to create a spin-out company to work in a promising, highly profitable industrial field, and the Science Park team found a private company in the sector which was willing to get involved and to invest the rest of the required money. The researcher's boss (the research unit manager) took a radical stance against the project. As a consequence, the researcher's motivation plummeted. The creation of the spin-out was abandoned.

Our research showed that the opposite situation did not lead to the opposite conclusion. When the head of the research unit was willing to get involved in knowledge transfer activities, the unit's researchers were not necessarily forced to follow them, with the default option pointing towards not investing time and effort in knowledge transfer activities.

This fact has remarkable implications for universities' technology transfer units (Science Parks, TTOs, etc.). Their work has traditionally focused on the internal identification of research areas that can potentially be applied to industry. However, assessing the willingness of the different actors involved as well as their hierarchical level and their ability to exert internal influence become crucial. Consequently, our research shows that institutional stakeholders' commitment is far less important than individual motivation and commitment, thus reinforcing the findings shown by the literature.

There are many different factors that influence the lack of willingness to undertake knowledge transfer activities. Our research identified the Spanish legal framework as being the most relevant indicator. The progress of researchers in their professional university careers depends almost exclusively on their publication activity. The weight of their knowledge transfer activities on their career progress is almost irrelevant. Additionally, this legal framework imposes rigid limits on agreements between companies and public universities.

On the other hand, the different backgrounds, goals and attitudes of researchers and industry members explains the lack of understanding introduced by Hall, Link and Scott (2001). Research needs long deadlines to bear fruit. However, researchers are used to this kind of pace, yet for companies, long periods of time entail major costs. Knowledge transfer activities are more demanding in terms of deadlines than in terms of preciseness for companies, thus distancing them from researchers, whose concerns are the opposite.

Industry willingness to invest in innovation, and in sourcing this from university knowledge, is not widespread either. Consequently, an analysis of this predisposition and how it is distributed is highly pertinent. Our research showed highly irregular distribution of this willingness, based on company size, economic sector and clustering ratings, as well as the personal attitude of the company management team.

On average, the institutions that brought together these companies were more convinced about innovation and tried to engage with universities and involved them in their projects. Nevertheless, these institutions' officers showed a clear need for command and recognition, which is something that must be taken into account when managing relationships with them.

On the other hand, the people we interviewed who were in charge of these institutions also expressed their concern about their lack of understanding with researchers. This misunderstanding pushes companies in search of available knowledge to look to other, and perhaps less promising, knowledge sources. This literally means that universities are losing opportunities to transfer their knowledge. In fact, only 9.78% of Spanish companies identified university research units as their main partners in this area (INE, 2019).

Overall, our research showed that the answer to the why question could lie in a small part of the possible industry-university matches. Nevertheless, the potential of this small part could justify the effort of setting up satellite offices, and any analysis carried out must focus on this small part and be more fine-grained. The most innovative companies in the region are, in fact, ready to make relevant efforts to capture knowledge from the university. One of the industry participants described the efforts of a company in trying to increase the number of skilled people from a particular field that it needed to growth. The company welcomes interns and tried to convince the university's top management to set up a specific Master's degree in the area that was only available at the University's main site. This example suggests two interesting findings. Firstly, university-industry collaboration, which currently focuses on the university's second and third missions, should be extended to the first as well. In some way, an extended helix model including all the university missions would help to identify robust new synergies. Secondly, this extended university-industry collaboration, including the first mission, could be particularly useful for peripheral regions.

The possibility of knowledge transfer could come from the unlikely coincidence of a researcher willing to get involved in this kind of activity and a manager willing to explore the university as a source of knowledge. The experience of one of the interviewees illustrates this statement. An entrepreneur who had been working in fruit and vegetable marketing for 13 years, was looking for a better way to label their products. Someone told this entrepreneur that a researcher had been doing research into labelling fruit by laser at the University of Valencia. When they met, the researcher, who was also willing to transfer his knowledge, did not have to add a word, and simply opened his drawer and took out an orange with a laser-etched label on its rind. The result of that meeting was the creation of a spin-out company that today sells laser devices around the world for labelling fruits and vegetables (laserfood.es).

In our specific case, our analysis defined the goals listed in Table 3 for the satellite sites of the University of Valencia's Science Park. We have included this non-general information in this paper to illustrate the result of the process. In entrepreneurial activities, satellite sites should adopt a subordinate position, leaving the leading role to other institutions. Focus must be on other transfer activities.

Table 3. General goals of the University of Valencia's Science Park satellite sites

- To facilitate the connection between selected University's research units and selected companies in the region, promoting collaboration between them.
- To provide advanced services for research activities to both, companies in the region and joint research projects.
- To provide advanced incubation services for highly innovative local entrepreneurial talent, in collaboration with industry organisations operating in the region.

6.2. What?

The interviewees found many of the tasks usually done by science parks to be useful, and they also welcomed the idea of these being offered by potential satellite sites. Therefore, we paid specific attention to some of these tasks that interviewees found particularly relevant, and specifically to those that have not featured strongly in the literature.

The relationship between companies and university research units lasts over time, once it has been established, with recurring collaboration projects being common place. Occasionally, the research unit becomes a kind of R&D department for the company. In economic terms, this means that even major efforts to match specific companies and selected university research units can bring profitable returns over time. To a certain extent, this finding broadens the vision shown by the literature, which mostly associates long-term relationships with the creation of permanent structures (Ankrah et al., 2015).

The first contact between companies and universities usually needs help from specific units, like science parks and TTOs. Researchers lack networking abilities, thus resulting in inefficient, powerless efforts. This lack of results discourages both sides of the relationship to make more efforts. Most of the interviewees thought that a science park satellite could create value by driving networking, and this networking would be more successful if it was undertaken from a location closer to the companies.

Many interviewees found that the provision of specialised infrastructure, R&D equipment and expert staff was another area in which a science park adds value. Nanotechnology delivered a good example. Research related to all its applications needs to measure the size of nanoparticles. A research unit of the University of Valencia organised several events in collaboration with firms that manufacture and market devices to cater for this need, to showcase this technology and its utilities. Many people from companies around the Science Park attended these events, and some of them bought devices. The case of one of these companies became really significant. This company did not take the equipment out of the box, instead asking the research unit to do its measurement tests. They thought, after purchasing the device, that the research unit team was better prepared to run these tests and to provide better, more comprehensive reports than their own team.

Additionally, the provision of specialised infrastructure, R&D equipment and expert people could be also useful for local entrepreneurs.

Researchers' lack of understanding of company management principles also emerges when they try to create spin-out companies. The university units that have created spin-out companies seem to be more comfortable, in general, if these are managed by people who come from industry. There are exceptions, of course, meaning that spin-out companies managed by entrepreneurial researchers that do understand market rules and the corresponding management implications are successful. Bringing people together from both sides therefore becomes a useful way to create successful spin-out companies and going to the territory could facilitate this kind of approach.

In our specific case, the tasks to be undertaken by the satellite sites of the University of Valencia's Science Park are listed in Table 4, and all of them focus on the fields of the UV units willing to get involved in transfer tasks. Most of them were suggested by university interviewees, as examples of useful activities that they had carried out at some time. These could be generalised with the support of the Science Park and its satellite sites, if they exist.

Table 4. Activities to promote collaboration between the University and local companies

- Activities to showcase the knowledge available at the university to industry, mainly focused on the region's most salient economic sectors: organisation of sales presentations, seminars and debates, open scientific congresses and conferences, etc.; publication of newsletters, magazines, forums on the internet, etc.
- Activities to identify and promote possible collaboration opportunities: conducting surveys and interviews with local business executives and owners; creation of platforms to match industry needs with the corresponding university capacities; organisation of competitions and awards to cater for specific company needs.
- Activities to support the local entrepreneurial ecosystem in conjunction with regional economic agents: specialised business incubation space and services; virtual tenancy; early start-up support services; services to promote multilateral collaboration.
- Activities to support spin-out efforts (only in La Vall d'Albaida): identification; search for possible partners; start-up support services.

It is interesting to point out that we have not included anything about the first mission of the university (teaching) in Table 4, contrary to what has been suggested above. Universities have progressively evolved to a higher level of collaboration with industry, but decisions related to the core portfolio of studies still follow a unilateral process which is obviously out of the scope of technology transfer units. Our findings suggest that beneficial synergistic effects, which may be required to break even in a small region, could be missing, although they have not been considered in our case.

6.3. How?

Effectiveness is the main criteria when talking about what science park satellite sites should do. Both effectiveness and efficiency, are relevant when we ask the how question. The size of the regions raises questions about whether satellite sites can reach critical mass in certain activities, particularly those involving:

a. Costly special equipment, such as the devices used to measure the size of nanoparticles. Conversely, equipment used to manufacture 3D prototypes could be used by a broader range of actors.

b. Highly skilled professionals, such as people trained to operate the specialised equipment, and start-up mentors.

The critical mass issue could be solved by providing the most specialised services at the head headquarters offices of the science park or the university. Additionally, science park satellite offices could offer other services but provide them online, such as software for research, as well as access to research-related databases.

In our specific case, Table 5 gives a first approach to the resources required at the satellite sites of the University of Valencia's Science Park.

Table 5.- Basic definition of the required resources and procedures in the satellite sites

Main human resources:
- Facility manager: in charge of the facilities and its basic services.
- Technology transfer agent: managing the relationship between the university research units and all the innovation ecosystem agents (with different profile for each region).

Main facilities:
- Reception and multipurpose room (training, meetings, etc.).
- Coworking space for on-demand or permanent use.
- Some small private offices for one, two or four people.

Main procedures:
- Registration of new tenants and changes in their profiles.
- Reservation of on-demand or permanent spaces, services and specialised equipment provided by the headquarters of the UV and its Science Park, etc.
- Organisation of open or restricted activities.

7. Conclusions, limitations and further research

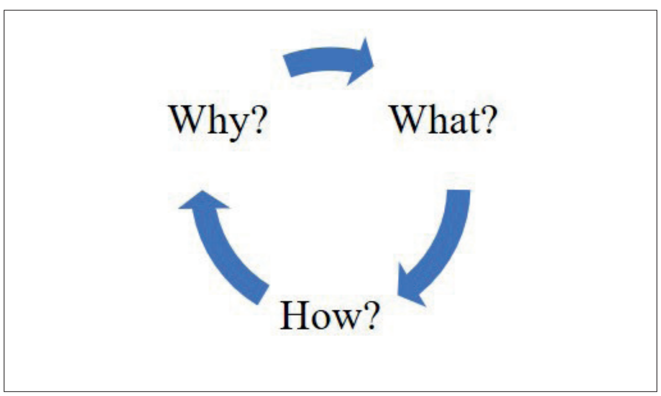
Our framework reshapes the evaluation criteria for a science park to be more proactive (questions to be answered) when making decisions about the creation of science park satellite sites. Answering the Why-What-How questions makes it possible to usefully address this kind of decisions. The most relevant one is whether to create or not these satellite sites. Even when there seems to be some consensus about the advantages of investing in science park satellite sites, differences in goals, attitudes and starting points between the involved stakeholders recommend an in-depth study of the possible outcomes of this kind of investments.

A few future knowledge transfer opportunities can make this kind of investment profitable but, do these opportunities really exist? The answer to the why question then becomes key to forecasting satellite site profitability. Our research shows that it is essential to go beyond the differences between stakeholders, opening the black box. Differences existing within the stakeholder units, such as university's research units and business associations, could be crucial for decision making. Furthermore, significant investment such as a science park satellite site must take advantage of all the systemic effects if it is to be successful. These systemic effects could come from extending university-industry collaboration to the first mission of the university (teaching), although this seems difficult given the current structure and decision-making processes on the university side. This finding reinforces the need for future analysis of the complex processes of interaction between academia and industry (Kunttu, 2017; Skute et al., 2019).

Effectiveness and efficiency drive the answer to the what and how questions, thus moderating the answer to the why question. This means that a well-designed satellite site service portfolio can affect whether it breaks even. As a line of future research, we suggest applying the quadruple helix model to the university as a whole, including its three missions, as well as the study of the benefits that the university can obtain from its extension.

In addition, the process (the framework) becomes circular, requiring additional cycles to accommodate the answers (Figure 1).

Figure 1. Our framework to make decisions about the creation of a science park satellite site



Our research has brought other conclusions that may have general applications when trying to bring the work of a science park to its territory through the creation of satellite sites. However, the literature suggests that these other conclusions could have less validity in developing countries, given that our case is framed in a developed country and there are significant differences between both types of countries in terms of university-industry collaboration processes (Nsanzumuhire & Groot, 2020). Until now, the focus of the few existing satellite sites has centred on offering services related to start-up activities in general. We found that the work of these sites would add more value if they also focus on encouraging industry-university agreements, particularly when these agreements can be maintained in the long term or can give rise to spin-out companies. Technology transfer agents could be more proactive if they worked closer to its territory, thus maximising the available value. These agents need in-depth knowledge about both sides of the potential agreements (university and local industry), as well as professional handling of management tools: marketing, networking, resource planning and optimisation, negotiation, and even some social psychology.

Our exploratory work suggests some lines of further research in two main directions. The first one would be to extend our exploratory work to move towards greater understanding of the outcomes we have discovered. For instance, how can the work of technology transfer agents be fitted to small numbers (small geographical areas in particular)? How can it be more proactive (to capture all the existing value in the area)? Additionally, how can this work change the factors that discourage technology transfer?

On the other hand, our work reveals additional drawbacks to the task of assessing the performance of transfer units. How can the real impact of promoting long-term relationships or creating spin-outs be measure when their effects materialise many years later? More work is needed in this direction.

Finally, checking our framework in the context of developing countries could lead to different conclusions, thus enriching our knowledge about the performance of university-industry collaboration mechanisms.

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