

Author's accepted manuscript (postprint)

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Published in: Lecture Notes in Mechanical Engineering

DOI: 10.1007/978-3-030-48021-9\_101

Available online: 18 Aug 2020

Citation:

Hermann, R. R., Thomas, E. & Pansera, M. (2020). Science and technology parks as innovation intermediaries for green innovation. In J. P. Liyanage, J. Amadi-Echendu & J. Mathew (Eds.), Engineering assets and public infrastructures in the age of digitalization (p. 915-922). Lecture Notes in Mechanical Engineering. Springer. doi: 10.1007/978-3-030-48021-9\_101

This is an Accepted Manuscript of an article published by Springer in Lecture Notes in Mechanical Engineering on 18/08/2020, available online: [https://link.springer.com/chapter/10.1007/978-3-030-48021-9\\_101](https://link.springer.com/chapter/10.1007/978-3-030-48021-9_101)

# Science and technology parks as innovation intermediaries for green innovation

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**Abstract** This paper discusses how science and technology parks (STPs) act as intermediaries for projects regarding green innovation. The empirical evidence is gathered through a case study of the City of Knowledge in Panama. For the recent Panama channel's expansion, local authorities faced the need to improve the water resource management to secure enough fresh water for the canal's operation. We inductively analysed data from 24 interviews, documents and participant observer. Preliminary results show the intermediation of STPs in green innovation processes in three phases: a first intermediation process is the STP as a hub for knowledge generation, including training for entrepreneurship. A second stage of the park as an innovation intermediary regards to an arena for knowledge and technology transfer, including collaboration with universities. A third phase implies financing and brokerage of green innovation between local and global actors. Our results challenge the existing literature about STPs with a narrow focus on economic spillover effects, or as hubs for attracting and developing cutting-edge technological innovations.

## 1 Introduction

Literature about science and technology parks (hereafter just STP) has grown exponentially in recent years, becoming a central topic within innovation man-

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agement, industrial policy and science and technology studies (Hobbs et al. 2017). Research about STP in sustainability issues, however, remains fragmented. Some scholars focus on pollution control and end-of-pipe technologies, especially in southeast Asia (Wu et al. 2006). Other researchers seek to apply cleaner production principles to the operation of science parks (Chen et al. 2015) or the inclusion of sustainability goals in strategic planning (Ribeiro et al. 2016). However, there is a lack of studies about STP' role in supporting the generation of green innovation, contrasting to the vast literature examining support to start-ups and knowledge spillovers (Todo et al. 2011), or research on regional growth and science parks (Zhou 2005; Zhu and Tann 2005). As actors that join several other organizations, STP act as intermediaries (Löfsten & Lindelöf, 2002) providing different sets of services towards helping collaborative innovation projects (Thomas et al. 2017). However, more theorizing is necessary to address the gap of knowledge on the role of science parks in green innovation as intermediaries for projects in their hosting regions. Therefore, in this article we address the question: *how are science and technology parks acting as intermediaries for the generation of green innovation?*

To help answering this question, we research one case study, City of Knowledge, a STP located in the proximity of the Panama Canal (Dettenhofer and Hampl 2009). Panama authorities have recently faced the challenging situation of having to balance the construction of the channel's extension for commercial purposes with the needs of the country's citizens, and the social and environmental problems this activity causes (Floris 2012; Carse and Lewis 2017). The science park, along with other actors in the Panamanian innovation system, is a key actor in achieving this goal.

Our paper contributes to two streams of literature. First, we aim to fill the gap of knowledge about the role of STP in fostering and supporting the generation of green innovation. Second, we add to innovation intermediaries' literature by theorizing about intermediaries' roles in inter-organizational collaboration for green innovation. We structure the paper as follows: section 2 presents a literature review focused on the science parks as innovation intermediaries. Section 3 presents the materials and methods. Section 4 presents findings from the case study and the discussion of results. Due to limitations of space for the paper, we opted to present them together. Finally, section 7 presents preliminary conclusions taking into account that this study still seeks further discussion.

## **2 Literature Review**

### **2.1 Science and technology parks as places in which innovation is created**

Science and technology parks (STP) are organizations with the main aim of promoting the culture of innovation and competitiveness for firms, universities

and R&D institutions. This can be delivered for the associated organizations via facilities and high value-added services (IASP, 2018). STP can also include incubators and accelerators to facilitate the creation and growth of new technology-based companies. Ratinho and Henriques (2010) argue that the two most important characteristics for the success of STP are university links and suitability of management. Löfsten and Lindelöf (2002) also state that “the assessing of academic knowledge and expertise by businesses located on-site is a key principle of Science Parks”. By creating supportive spaces for knowledge and technology-based firms, STP may also facilitate technology transfer and help companies’ growth (Guadix et al., 2016). This way, STP may become important drivers of regional development (Löfsten & Lindelöf, 2002).

## **2.2 Science parks as intermediaries of inter-organizational relationships and governance of networks**

The fact that actors geographically located close to each other interact more easily helps to explain the role of STP in the support for the generation of innovation through inter-organizational collaboration (Villani et al., 2017). As seen, one of the main characteristics of STP is the connection of companies located in the facilities with universities and research centres for knowledge sharing aiming at the creation of innovation. Networks provided by science parks benefit also new firms based on technology (Löfsten & Lindelöf, 2002). However, Ratinho and Henriques (2010) found that the mere proximity of STP with universities is not enough for their success. Besides internal partners, Guadix et al. (2016) say that STP also aim to cooperate and promote cooperation with other actors in the public and private sectors, and these external collaborations have a positive effect on the outcomes of companies. Therefore STP act as innovation intermediaries by facilitating the identification of external knowledge sources and by making external knowledge accessible (Agogué et al., 2017).

As such, STP are considered innovation intermediaries or brokers, which are broadly defined as organisations that provide services and support role for collaboration between two or more parties during different stages of the innovation process (Howells, 2006). Intermediaries are central to creating and maintaining a successful innovation ecosystem (De Silva et al., 2017). Park (2016) summarizes the roles of innovation intermediaries in facilitation, mediation, or coordination. According to Villani et al. (2017, p.87), intermediaries can purposefully influence proximity among actors through specific direct and indirect activities, taking into consideration that “proximities are strongly related to context-specific characteristics, such as the complexity of the knowledge being exchanged and the type of actor involved in the technology transfer.” Besides promoting proximity among companies, intermediaries provide a broad set of services to innovative firms and

collaborative projects, such as coordinating knowledge between actors through to commercializing new technologies (De Silva et al., 2017).

Regarding green innovation, “intermediaries can be critical to the exploration of new opportunities and the development of new ways to address shared issues, such as sustainability and environmental issues” (Agogu e et al., 2017, p.20). According to Ekins (2010), eco-innovation have complex political, institutional and cultural, in addition to technological and economic, dimensions. Coordination capability, which is the involvement of individuals and other firm resources across a company in regard to creating value for customers and other stakeholders, is positively related to green innovation (Huang & Li, 2017). Green innovation or eco-innovation, in this paper, is defined as innovation that results in a reduction of environmental impact (OECD, 2009).

### 3 Method

This research follows a qualitative approach through the case study technique.

#### 3.1 The case study: watershed management for the Panama canal extension

The case study is the science and technology park City of Knowledge (COK) involved in the Panama Canal extension. COK is at the same time a “Science, business and technology park” at the former USA military base of Fort Clayton, besides the Panama Canal; and, a “Knowledge Management Network and Node” (COK 2017). Its origins date back to 1977 when Panamanian president Omar Torrijos and the American president Jimmy Carter signed an agreement by which the U.S.A. government compromised to give back to the Panama government the full sovereignty over the Panama Canal Zone, including the land, water and existing infrastructure by 1999. The main purpose of COK is to encourage innovation, and to foster the establishment of research centres, and knowledge transfer organizations.

In 2007, the Panamanian government started a 6 billion USD project to expand the Panama Canal. The engineering activities required widening the canal’s entrances, deepening the canal, and building the infrastructure of the new locks (Spengler et al. 2014). The Panama Canal Authority (PCA) was the manager of the project. The success of such a megaproject in the long term depended on a secure supply of fresh water (Newbery 2017). In parallel, Panama authorities are in the challenging situation of having to balance the commercial activity of the channel with the needs of its own citizens, and the social and environmental problems this activity necessary causes (Floris 2012; Carse and Lewis 2017). The science park, along with other actors in the Panamanian innovation system are key actors in achieving this goal.

### **3.2 Data collection and analysis**

A total of 24 interviews were carried during three phases of data collection (2010-2016). The interviews targeted key informants at the higher hierarchy of organizations dealing with one way or another involved in transition processes linked to water resource management. Thus, advisors (6), consultants (2), directors (1), managers (8), professors (1), rector (1), officers (1) and researchers (3). These interviews were carried in the units of analysis: City of Knowledge and PCA, supportive interviews were also conducted. In total 5 interviews involved staff from PCA, NGOs(4), companies (5), research centres (1), universities (5), cooperation agencies (1) and government agencies (3). The semi-structured interview guides started with a broad discussion about previous or existing collaboration initiatives between the science park and the canal authority with focus on water resource management. When specific projects were highlighted more detailed questions were addressed in regards to the type of innovation developed along the project, and specific aspects of the innovation -resources, key actors and stages. Interview transcripts and field notes were coded using the software QSR NVivo. The analysis of data was performed according to the content analysis technique where the authors used previous literature to analyse empirical findings to generate implications to practitioners and to the literature.

## **4 Findings**

Due to limitations of space, we opted to present findings from the case study organized according to the literature regarding the roles of innovation intermediaries.

### **4.1 Knowledge and technology transfer**

Firms in the park related to green innovation and connected to the case of the canal's extension include consulting agencies, maritime R&D service companies, and clean tech companies selling technology. Environmental related activities of these organization range from environmental studies (like consulting companies which can prepare environmental impact assessments), capacity building (training on specific topics like ISO norms), sales of "clean technology" (renewable energies or waste management), or technology related to the maritime sector.

The case portrayed the value of STP to develop educational programs consultants, which become reliable for particular insights and capacity building. This finding is not a fortuity, in the literature, consultants' importance in the transformation of knowledge and innovation is often stressed (Swan, Scarbrough and Robertson 2003). Among non-for-profit organizations, there are research centres and academic institutions. From an environmental point of view, research centres'

work relates to policy, innovation, knowledge management and environmental studies. Academia comprises universities, NGOs and government bodies. Similarly, innovation promotion government agencies are also located in City of Knowledge. These agencies fund prizes for start-ups and finance settlement of human capital (national or foreigner researchers who propose research agendas). This examples correspond to Guadix et al. (2016) regarding the aim of STP to cooperate and promote cooperation with external actors in the public and private sectors.

#### **4.2 Knowledge generation**

Different from knowledge and technology transfers, interactions between City of Knowledge and ACP's environmental strategies aim at generating knowledge through the provision of education, training, and consultancy. Educational and training activities evidence interactions between industry, government and universities promoted by the park. In a first example, one private firm established at City of knowledge, created agreements with a major national university in order to launch a master program in Environmental management information systems. The government was involved as it provided funding for the program.

Another example of knowledge generation highly involving City of Knowledge is in the fields of medicine and biotechnology. The park has been attracting international firms which are gradually creating a cluster in these domains. Foreign Direct Investments may fund R&D in this case. Local universities train human capital doing research in these two areas. The knowledge generation, in the case of the cluster, happens around tacit and explicit types of knowledge through formal and informal means (Thomas 2018). In this case, the STP facilitates the identification of external knowledge sources and makes external knowledge accessible to firms, acting as an intermediary (Agogué et al., 2017).

Besides educational activities, consulting offers opportunities for interaction between organizations in City of Knowledge and ACP environmental division. For example, CATHALAC<sup>4</sup> has developed close links with ACP. From the one side, it has exploited its integrated water resource management experience by training ACP hired educators working on environmental education in the watershed: "We are about to start a project to integrate climate change adaptation to sustainable development plans" (interview CATHALAC). Similarly, other City of Knowledge based organizations have provided consulting to ACP's PCW protection programs (i.e. Ramsar, and the NGO Panama Verde).

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<sup>4</sup> Water Center for the Humid Tropics of Latin America and the Caribbean (*Centro del Agua del Trópico Húmedo para América Latina y el Caribe*)

### 4.3 Financing innovation

One interviewee, the head of the entrepreneurial innovation division from the National Innovation Agency, stated that it is not difficult to get funding in Panama; “the problem is not the money. The problem is to have good and competitive projects presented [to calls managed by national or international cooperation agencies]”. In Panama, government agencies provide direct funding for innovation. At lesser extent, other organizations including the City of Knowledge indirectly provide funding to innovation by administering external funds that come from international cooperation agencies. The access to financial resources as a fundamental resource for a collaborative R&D project is regarded as one of the roles of innovation intermediaries (Thomas et al. 2017). At the City of Knowledge, a private equity group called ECOS S.A. finances projects dealing with renewable energy, community tourism, biofuels and others. Yet, its operations are regional (e.g. Latin –America, with most projects located in Colombia and Brazil).

## 5 Conclusions

This paper aimed to analyse science and technology parks acting as intermediaries for the generation of green innovation. We presented the case study of City of Knowledge, a park located near the Panama Canal and involved in the project for the watershed management on the constructions for the canal’s extension.

From our data, we can see that City of Knowledge Foundation’s interest to promote the science park as a hub to develop knowledge on natural resources management, such knowledge emphasizes new modes of institutional innovation. Hence, the case illustrates a particular type of “green innovation” focused on new institutional modes of natural resource management. This has consequences as ICT and bio-tech organizations seem to quantitatively dominate over environmental services providers. Thus, it gives an impression that no specialization can be expected in City of Knowledge with regard to green technology or services. Even though, our analysis showed the intermediation of the park in green innovation processes. These activities can be organized in three ways: a first intermediation process is the STP as a hub for knowledge generation, including training for entrepreneurship. A second stage of the park as an innovation intermediary regards to an arena for knowledge and technology transfer, including collaboration with universities. A third phase implies financing and brokerage of green innovation between local and global actors. Our results add to the existing literature about STPs which present mostly a narrow focus on economic spillover effects, or as hubs for attracting and developing cutting-edge technological innovations.

Nevertheless, the proximity of the STP to the canal has hitherto not yielded with the creation of a “green cluster”, which could be a precedent to better promote green innovations. Our findings suggest that interactions of the science park with the Panama Canal Authority and other actors in the region are not institutionalized but take place through adhoc projects. Therefore, there is opportunity for the STP to establish itself clearly as an intermediary and service provider for collaborative projects between industry, universities and governments. Although this paper generates insight for further discussion on the role of science parks as innovation intermediaries for green innovation, we acknowledge some limitations to its results. As a single case study, it does not allow the validation of results to a wider population of STP. Also, the Panama Canal extension present some unique attributes of its case that may not be found in other projects regarding green innovation.

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