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A city and its Science Park: building a local innovation system for urban and economic development

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A City and its Science Park: building a local innovation system for urban and economic development

Executive Summary

In July 2000, at the city of Recife, in the northeast region of Brazil, a joint venture involving Government, Academia, and the Private Sector, created the Porto Digital Science Park. Eight years later, Porto Digital hosts over 100 firms in the information and communication technologies (ICT) industry, 70% of the local software industry GDP, universities, and R&D centres of global ICT leaders. Porto Digital was created with the goals of launching the local ICT industry in global markets, reshaping local economy, and, at the same time, reviving the historical port area of Recife, which had been for centuries the city's cultural and economic heart. The first goal of this article is to present Porto Digital as a case-study of a successful and synergistic local development endeavour. The second is to describe a conceptual framework elaborated and refined during the practical experience, which could be used to guide similar projects elsewhere.

1 Introduction

In July 2000, at the city of Recife, in the northeast region of Brazil, a joint venture involving Government, Academia, and Private Sector, created the Porto Digital Science Park. Guiding the development of the science park, there is the vision that the city of Recife can become a global player in the information and communication technologies (ICT) sector. In this vision, Porto Digital has the role of catalyst, articulator, and animator of the different actors of the business ecosystem, supporting and stimulating the establishment and consolidation of co-operations and collaborations among companies and organizations in a competitive environment.

By the end of the year 2007, Porto Digital hosted over 100 ICT companies, 70% of the local software industry GDP, universities and other higher education organizations, and R&D centres of major global ICT leaders like Motorola, Samsung, Nokia, Microsoft, IBM, SUN Microsystems, among others. Porto Digital also hosts the most innovative R&D institute of Brazil, called C.E.S.A.R (according to a Federal Government assessment in 2004), was evaluated as the largest science park in Brazil in 2005 (AT Kearney, 2005), and in 2007 won the prize of the best Brazilian Science Park, given by the Brazilian Association of Science Parks and Business Incubators (ANPROTEC).

The long term goal of Porto Digital is the development of a "technology city" based on the urban rehabilitation of the traditional port area, at the historical quarter of the City of Recife

known as "Bairro do Recife". As describe by Gonçalves and Reynaldo, "This new town will spring from interventions that aim at creating a world-class technology business environment based on the recycling of the obsolete and underused buildings of the [traditional] port area." (2002). Figure 1 shows the island where Porto Digital is located.

Figure 1: The Island of "Bairro do Recife" (Source: Imago Fotografia)

To understand the context, challenges, and goals that shaped the launch of the Porto Digital, one has to understand the economic history of Recife and the port area, briefly described here.

In the colonial times (early 1500s), the economy of Recife was heavily based on sugar exports, produced in the sugarcane mills around the early town. In this economy, the port played a major role, being the actual place from where the town was born. During over three hundred years, the port and the city grow intermingled, driven by the trade and financial business that sprung from the export activities.

The decline of the traditional economy, markedly the sugar exports, which started around the yearly 1950s, produced negative impact on both the port activity and, consequently, the urban life around the port area. Furthermore, at the same time, the industrial sector did not achieve the levels of competitiveness of other states of the country, and thus was not able to replace the agricultural sector as the main support of the local economy. The downturn reached the service sector in the late 1980s, when services bureaus (ICT included) of large companies, like banks and retail companies, started to move to the south of Brazil (mainly to São Paulo State) following a global trend of consolidation to achieve gains of scale.

Since the 1970s, the challenges of the local economy were quite complex. At this time, the global changes in production, that had became more knowledge-intensive, started to impose changes in competition, since firms worldwide started to compete on the basis of innovation. The productive sector in the State would have to answer to these challenges and one answer could be to innovate in modern sectors of the economy. The ICT sector was a strong candidate because of the existence of three complementary conditions: sector specific incentives at national level; a world class local knowledge and technology production cluster structured around the Federal University; and a qualified and consolidated group of software companies with national visibility.

Therefore, stakeholders from various segments of the local Society have embarked on a long term endeavour that has two highly ambitious goals: to launch the local ICT industry in the orbits of global markets, reshaping the local economy and regaining national and international visibility, and, at the same time, reviving the historical port area of Recife, which had been for centuries the city's cultural and economic heart.

The strategy adopted had two goals: to foster an environment of innovation with the creation of a Science Park; and to locate the Science Park in the traditional port area. The intention

with these two combined goals was to achieve gains of scale such that the economic and urban development would benefit from each other in a dynamic way.

This article is organized as follows. In Section 2, the three stages of evolution of the Science Park are presented. In Section 3, the three drivers that formed the pillars of the strategies of the Science Park development are described. In Section 4, a conceptual framework, elaborated and refined from the practical experience, is presented. Finally, in Section 5 some concluding remarks are presented.

2   Three Development Stages

The idea of an urban science park in the traditional port area of Bairro do Recife and focused on the ICT sector was launched by the State Government during an strategic meeting of the State's Development Forum. The government, industry, and the academia were represented at the Forum, which approved and supported the original idea constructed in a partnership between the State Government and the University. At this meeting, the State Government committed about US$ 15 millions in investments on infra-structure and building, incentives for firms, and the Park's management.

In nearly eight years, Porto Digital evolved from a couple of sketches and slide presentations to become the largest and one of the best science park in the country. This evolution will be presented by a framework of three stages that provide an understanding of the growth pattern of the Science Park. Such framework serves a didactical purpose and can also be useful for policy makers and park managers in their understanding of the nature, characteristics and problems of a science park.

In ths framework, each stage will be characterised by six factors: two strategic (Challenge and Central Strategy), and four of a managerial nature (Founder's Involvement in Park's Management, Focus of Public Investment, Main Activities, and Results[1]). Each stage is named based on the three first stages of the framework presented in (CHURCHILL and LEWIS, 1983): Existence, Survival, and Success. In this work, the name Sustainability will be used instead of Survival because it represents better what "survival" means for a science park. This work only considers the first three stages of Churchill's framework, but this does not imply that the other two stages (Take Off and Maturity) do not apply in the science park context.

2.1 Existence: launching the strategy and creating the park

The main *challenge* after the launching of the idea of Porto Digital was to gain acceptance and support from important local actors: local government, local ICT companies, other universities and academic institutions, the National Heritage Institute (that regulates development of heritage protected areas, like where Porto Digital is located), syndicates and associations, among others. Besides, since Porto Digital would be located in an urban area, support from local businesses and citizens already located in the area would be very important.

The *central strategy* at this stage was to create territorial conditions for the beginning of the Park's operation and the incentives to attract companies to the Park area. Supporting this strategy, institutional communication was carefully planned and executed to inform stakeholders and local business and citizens about the Park's development.

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[1] Source: Annual Reports of Porto Digital Management Unit (NGPD), found at http://www.portodigital.org.br.

To implement this strategy, in August 2000, a task force was created at the Technological Institute of Pernambuco with a charter to manage the initial studies and activities to implement Porto Digital, in three aspects:

- **Governance**: to define the nature and structure of an organization to manage the Park.
- **Urban development plan**: to study and plan the strategic location of anchor organizations and companies to enhance linkages and communication among them, together with the projects to improve urban infra-structure in the area.
- **Incentives**: definition of specific fiscal and financial incentives for companies to be attracted to the Park.

In the governance aspect, the task force proposed the creation of a non-governmental organization (NGO) to manage Porto Digital's implementation and operation in a continuous basis. This NGO, called Porto Digital Management Unit (NGPD), was founded in December 2000 by the main stakeholders of the project, including members of public, academic, and private sectors, as well as from other NGO's. In April 2001, NGPD received the qualification of "Social Organization" at the State level, which "provides a private framework for the implementation of public policies" (PORTO DIGITAL, 2008), allowing NGPD to celebrate contracts with State Government to manage most of the public investment in the Park.

The qualification as Social Organization accelerated the pace of the projects, in particular, those of building reconstruction and urban infra-structure. Furthermore, in the fulfilment of its mandate, NGPD produced an Strategic Plan for the Science Park that guided Porto Digital initial development and is still used as a conceptual basis for the management of the Park. Besides, the brand "Porto Digital" was created and promoted locally and nationally since the early days of the Park, developing an identity that soon became known all over the country.

NGPD has a steering committee formed by 17 members (19 originally) representing several sectors of the local Society. Below the committee, NGPD is managed by a Board of Directors. This governance structure provided agile management as well as an important point of communication, contributing to the acceptance and support of the project. At this point, the *founders* of Porto Digital were deeply involved in its management, being part of the Board of Directors, as well as developing policies and strategic activities on the steering committee and on key in positions in the State Government.

The first version of the urban development plan of Porto Digital was released by mid 2001 pointing towards two complementary visions. First, a short to medium term plan to place organizational anchors of the Science Park in strategic buildings and to implement the infra-structure for digital communication. Second, a long term urban transformation plan that defined preferential occupational patterns for the Science Park direct (business buildings, R&D centres, universities and other vocational institutions, etc.) and indirect (commerce, fitness centres, shopping malls, hotels, housing, etc.) uses.

Using the urban plan, the *main activities* developed in the Existence Stage of the Park were the construction of digital communication infra-structure and the redevelopment of buildings to host four anchor organizations: a business incubator, a technology transfer centre, an office building, and a State Government Secretariat. These anchors were transferred to Porto Digital by the end of 2002. Furthermore, NGPD also worked together with Municipal and State Government in the development of a set of incentives for the ICT companies that were interested in moving to the Science Park.

The infra-structure and building redevelopment projects, the installation of the organizational anchors, and the incentives worked together to create favourable conditions for the attraction of local and national ICT companies. As the *Result*, at the end of 2002 Porto Digital hosted nearly 50 organizations among ICT companies, support services, R&D and technology transfer centres, associations and syndicates of the ICT industry, among others.

These organizations brought 920 new job positions to the Park, requiring the redevelopment of over 12.000 square meters of historical buildings.

The end of the infra-structure and the redevelopment projects, and the creation of the incentives marked the end of the Existence stage of Porto Digital.

2.2 Sustainability: consolidating the brand and searching for financial sustainability

The successful development of the Existence stage placed a new *Challenge* to the development of the Science Park: to keep the good moment going. The management of the Park had learned that continuous communication with all stakeholders and organizations in and out the Park was essential to keep acceptance and support at high levels and, therefore, to keep the inflow of resources and new companies to the Park. This has been called by Felipe Romera[2] as the "animation of the Science Park" and is considered by him and other practitioners to be a key ingredient in successful science park projects.

This new challenge was addressed by a *central strategy* with two complementary goals: to consolidate the image of the Park and its companies, and to enhance linkages among companies and between them and other organizations. This can be confirmed by the following text extracted from NGPD's website:

> "In the second stage of operation, NGPD is working for the ongoing development of the business environment through technical cooperation agreements and technology transfer, as well as encouraging integration between companies. In addition, it promotes both nationally and internationally the image of the Local Production Cluster as an island of excellence in the ICT field." (PORTO DIGITAL, 2008)

The Board of Directors was changed in 2003 to align management with the challenges and strategies of the new stage. The founders of NGPD left the Board, leaving the place for professionals hired from the market. At this point, the *founders* were involved in the evaluation and evolution of policies and in providing strategic support to the Board from positions in the steering committee and the State Government.

Public investment shift according to the new strategies, focussing on the promotion of the Park and its companies in the national market and on the management of NGPD. As the public money started to become more focused on specific activities, NGPD searched for revenue from other national (FINEP and SEBRAE) and international (InfoDev/World Bank, AED/USAID, and UNIDO/ITPO) sources to finance its activities.

The *main activities* of the Park reinforced the focus on "keeping the good moment going". The anchor organizations started full operation, contributing to the establishment of formal and informal linkages among companies and between them and other organizations like the universities, business incubators, technology and R&D centres, among others. Great effort had been put on the consolidation of the Park's image nationally and internationally, evolving the work on brand creation developed in the previous stage. Besides, to support the growth of the Science Park, the State Government donated a building with nearly 12,000 square meters to be managed by the Park.

As the *Result* of the Sustainability stage, at the end of 2006, Porto Digital hosted 100 companies that generated 3,500 job positions in the Park area. The amount of office space occupied by companies in the park reached 30,000 square meters, which is about 15% of the total available space in Science Park area.

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[2] Dr. Felipe Romera is the President of the "Parque Tecnológico de Andalucia", in Málaga, Spain. He discussed the concept of "animation" of a Science Park with the Directors of Porto Digital during his visit to Recife in 2001.

By the end of 2006, Porto Digital had reached the end of the Sustainability stage according to a number of indicators: anchor organizations were fully established and operating, the Park was participating in important international networks, 100 companies were located in the Park, new office space acquired by NGPD offered growth possibilities, among other achievements.

The year 2006 was also marked by elections for the State Government that, after eight years, was won by a political party from the opposition to the previous Government. For the first time since its creation, Porto Digital would have to negotiate State political support and investment with a Government from the opposition. The impacts of the changes in the political landscape are still to be evaluated.

2.3 Success: defining new challenges and deciding to grow

The recognition as the largest science park in the country, with a consolidated image and a record of successful achievements from its companies and organizations, marked the start of the Success stage of Porto Digital development. This success has been confirmed in 2007, when Porto Digital won the prize of the best Brazilian Science Park given by the Brazilian Association of Science Parks and Business Incubators (ANPROTEC).

Therefore, one could imagine the Success stage to be an easy ride towards even more achievements and steady growth. However, the decision to grow and how to do that are the main *challenges* that Porto Digital faces at this stage for two main reasons. First, the new political scenario at the State level changed the relationship between Porto Digital and the State Government, with corresponding impacts on funding and political support. Second, to grow significantly from a basis of 100 companies and 3,500 jobs will require office space and infra-structure that will have to be redeveloped in the Park. The costs of that, without public investment, could be economically unfeasible for the companies to bear alone. Signs of this problem had emerged in the near past when two important and relatively large companies decided to locate their branches in Recife outside the Porto Digital area.

Central strategy at this moment is being reshaped in two complementary ways. First, to improve the business environment to achieve more innovation and competitiveness in companies. Second, to extend the influence of the Park to other regions of the State of Pernambuco.

With the change in the State politics, the founders of Porto Digital that worked in Government left their positions. Therefore, the *involvement of the founders* at this new stage became restricted to participation in the steering committee of NGPD. As mention above, *public investment*, as long as State Government is concerned, has changed accordingly to the policies of the new Government in place. NGPD had to diversify its funding options, including the proposition of specific projects of interest of the public sector.

During the early moments of the Success stage, *activities* are still resumed to regain financial capacity through funding projects and the continuous administration of the Park's own office spaces. It is still too soon to talk about the *results* of this stage. Firstly, some key questions should be addressed by all involved with the Park, including:

- Is it necessary to grow to a next level and, if so, which level is that? More companies or larger companies, or both?
- If the decision is towards continuous growth, how to do that? Attracting external companies or having an indigenous process of enterprise generation, or both?
- How to finance growth, mainly in the required urban infra-structure?
- How to support growth regarding the supply of human capital and technology?
- How the Park could fill-in the gaps in processes of linkages, learning and investment to enhance the company's conditions to innovate effectively and become more competitive?

In short, the key question is whether Porto Digital will be able to consolidate its role as a major catalyst and articulator of the local innovation system and, therefore, take on a leading position in the development of the local ICT industry.

2.4 Summary of the Development Stages

Table 1 summarizes the characteristics of the Science Park at each stage of development. This cannot be considered a model, since most variables are still not formally defined and it has not been tested in other contexts. However, it could serve for policymakers and park managers as an account of a concrete and complex experience. It is being currently used as a road map in the development of similar science park projects in two other state capitals in Brazil.

	Existence 2000 – 2002	Sustainability 2003 – 2006	Success 2007 – …
Challenge	Acceptance and Support from local actors	Keep the good moment going	Growth to next level
Central Strategy	Create territorial and institutional conditions	Consolidate the image and enhance local linkages	Stretch out Park's influence and impact to other State regions
Founders' Involvement	Policy making, strategic planning, and direct Park management	Policy evaluation and strategic support to management	Participation in steering committee
Public Investment	Infra-structure, building and management	Marketing and management	Specific projects
Main Activities	Communication infra-structure, building refurbishment, urban plan development	Park's image consolidation, encouraging cooperation, anchor organization operation	Project planning and execution, innovation and competitiveness support
Results	50 companies, 920 jobs, 12,000 m^2 of office space	100 companies, 3,500 jobs, just under 30,000 m^2	…

Table 1: Characteristics of the Science Park at Each Development Stage

One of the uses of this framework is to understand how changes in certain factors influence others. For instance, it is clear that there has been a significant change in scale, scope, and priorities in the public investment, and that this changes caused corresponding modifications on strategy.

3   The Development Drivers

The primary goal for the implementation of Porto Digital Science Park was to attract to and retain individual talents and innovative ICT companies in Bairro do Recife. The central strategy was to consolidate and continuously evolve an innovative and competitive environment for the location and growth of these companies. To create and nurture such an environment, three development drivers were addressed, mainly during the Existence stage of Porto Digital's development:

- **Incentives for companies**: the creation a set of tangible (fiscal and financial) and intangible (image promotion and cluster effect) incentives that would attract companies to the Park.

- **Diversity of organizations**: Porto Digital should be the place of a variety of organizations that, together with the companies, would promote and support the linkages (cooperation), learning (tacit and non tacit), and investment, which are key elements of innovation (MYTELKA, 2000).

- **Territory qualification**: the territory of the Science Park, Bairro do Recife, should become a world class urban area to support modern organizations and companies, to provide high living standards to their employees, and to be attractive to their customers.

The three drivers are equally important. The underdevelopment of any of them would create gaps that would hinder the ability of Porto Digital to attract and retain the best companies and the most talented individuals.

3.1 Incentives for Companies

Incentives ware carefully planned and implemented to function as attractors for companies to transfer to the Park. NGPD has co-ordinated this process together with State and Municipal Government, associations of companies, syndicates, and universities.

These incentives took advantage of existing instruments and policies at national level, complementing those with specific local policies. Therefore, the portfolio of incentives is composed of national and local instruments that: support innovation through industry-university interaction; finance R&D, innovation, and human capital development projects inside companies; fund direct activities of the science park; finance building and infra-structure; provide low cost loans for ICT companies; and invest in projects to stimulate export of ICT products and services.

At the national level, the main incentives have been regulated and organized under a set of laws and public policies, such as:

- The Informatics Act, established by the Federal Government in 1991, is one key incentive for the location of R&D centres of multinational companies in Porto Digital. (Federal Brazilian Act No. 8.248, 1991 and No. 10.176, 2001).

- Federal R&D and Innovation Funds, created in 1999 to finance innovation in 14 economic sectors, including ICT.

- The support and regulation of industry-university interaction through the Federal "Innovation" Act (Federal Brazilian Act No. 10.793, 2004).

- The support and finance of exports of ICT products and services through the PITCE (Industrial, Technological, and Foreign Trade Federal Policy) (PITCE, 2003).

Together, these national instruments provided institutional and financial conditions for the development of local innovation projects. NGPD acquired competency in the development of projects that would channel as much Federal incentives as possible to Porto Digital and its companies. Using national incentives to leverage local incentives increased the capacity of Porto Digital to compete with other places in the attraction of companies and projects.

Tangible incentives (territorial, fiscal, and financial) were created at Municipal and State levels, as explained below:

- Territorial incentive:
  - Land use special conditions: the Municipal Government established special conditions for companies that want to redevelop historical buildings in the Park's area (Municipal At. No. 16.790).
- Fiscal Incentives:
  - Municipal Service Tax: this incentive reduces in up to 60% the amount of service tax paid by ICT companies located in the Park (Municipal Act No. 16.731, 2001).
  - State Sales Tax on Goods and Services (ICMS): this incentive reduces from 17% to 1% the ICMS for software companies in the State of Pernambuco.
- Financial and Funding Incentives:

- Loan Guaranty Fund: the Guaranty Fund for Software Companies in Pernambuco (FAESPE) provides funds to be used as guaranties in loans acquired by ICT companies in public banks (State Act No 11.634, 1999 and amended by Act 11.732, 1999).

- Human Capital Fund (FCH): created by the State Government, it is operated by the State R&D Funding Agency FACEPE and co-finances the development of ICT professionals for companies located in the Park.

- Risk Capital Fund (FCR): created by the State Government, the Fund invests risk capital in small and medium enterprises, with priority for those located at the Park.

- Zero Interest Loans: this is part of a Federal project created in 2004 to provide low interest loans to small and medium size "innovative" companies with little requirements on actual guarantees. NGPD is one of the five national agents that can operate these loans.

Territorial and fiscal incentives are decisive to attract companies to the park, since they increase company's overall competitive advantages and partially compensate the costs of heritage building redevelopment.

3.2 Diversity of Organizations

To support the creation of an environment that stimulates innovation, Porto Digital invested in attracting organizations with complementary roles regarding the intangible assets necessary for innovation: linkages, learning, and investment (NADVI, 1995). These organizations are called the "anchors" of the Science Park. Four of those organizations already existed and transferred all or part of their activities to the Park. The fifth one, the business incubator, has been created specifically to operate in the Park and started its operations in 2003. The roles of those organizations in Porto Digital are summarized below.

The State Secretariat of Science, Technology and the Environment (SECTMA)

This State Government authority is one of the public stakeholders of the science park and was its main investor during the Existence and Survival stages. SECTMA was also responsible for the definition and implementation of public policies related to R&D and innovation. In particular, the State Science and Technology Policy elaborated in 2001 declared Porto Digital as a priority project for Government investment.

SECTMA plays the important role of policymaker in science and technology that is necessary for the establishment of State level institutional framework to support innovation. Most public incentives at the local level have been defined or negotiated by SECTMA. Political and operational support given by a policymaking authority that was actively engaged on the initial stages of the Science Park has proved to be an essential asset for the success of the project.

SECTMA occupies a historical building in the Park that dates back to the 1920s. The building, with 1,740 square meters, has been redeveloped by Porto Digital as part of the investments in the Existence stage.

The Centre of Informatics of the Federal University of Pernambuco (CIn-UFPE)

The Centre of Informatics (CIn) is among the three largest academic institutions in ICT in Brazil. Currently, over 55 members of the academic staff hold a PhD or similar degree. It is the main organization responsible for the production of world class science, technology, innovation, and human capital in ICT in Recife. CIn pioneered the process of industry-university linkages in the region through entrepreneurship teaching (since 1996), academic spin-offs (over 20 companies), and joint R&D and innovation projects with large multinational companies (currently over 10 projects).

The entrepreneurial culture at CIn was an important ingredient in the launching of Porto Digital. The Centre participated from the very beginning in the design and implementation of the Science Park and is a permanent member of its Steering Committee. Furthermore, the first president of NGPD is a member CIn's academic staff.

The Centre has part of its activities, related to R&D laboratories in co-operation with ICT companies, located at Porto Digital.

SOFTEX Recife

Recife Technology Center for Software Exports (SOFTEX Recife) is a business association that congregates over 50 enterprises. Its role in the Science Park is to support, stimulate, and promote the development of software projects for export. SOFTEX is responsible for the redevelopment and operation of a business building located in the centre of the Science Park area. This digital condominium with over 5,000 square meters, will host companies in the ICT sector, most of them with a special focus on the export market.

C.E.S.A.R

The Centre for Advanced Studies and Systems at Recife (C.E.S.A.R) is an R&D and technology transfer centre that has span-off from the Centre of Informatics in 1996. C.E.S.A.R develops state-of-the-art solutions in ICT for public and private sector.

The Centre occupies a warehouse, with 2,000 square meters, in the northern side of the Park that has been refurbished by Porto Digital and equipped with the most advanced technology for R&D in ICT. It currently employs over 700 professionals in the Science Park.

CAIS do Porto

The business incubator of Porto Digital, CAIS do Porto, was created to host and accelerate the growth of new enterprises. It complements the roles of the other anchors in the support to the development of new competitive enterprises to inhabit the Park. The incubator also hosts mature companies that seek short term and temporary accommodations in the Park.

CAIS do Porto also hosts NGPD and has a fully equipped convention centre that serves as a meeting and integration point for companies and other organizations. It is strategically located right in the middle of the Park area, in an 18th century building, with 2,400 square meters, redeveloped by Porto Digital.

3.3 The Territory

Porto Digital is an urban science park located in a national heritage area, called "Bairro do Recife", which is protected by Federal Law. Bairro do Recife is an island, on the sea shore, with 100 hectares of total area. The Island also hosts the traditional Port that is still active and occupies nearly 50% of the island. Figure 2 shows an aerial view of the island with the location of the Porto Digital anchors and the traditional port area.
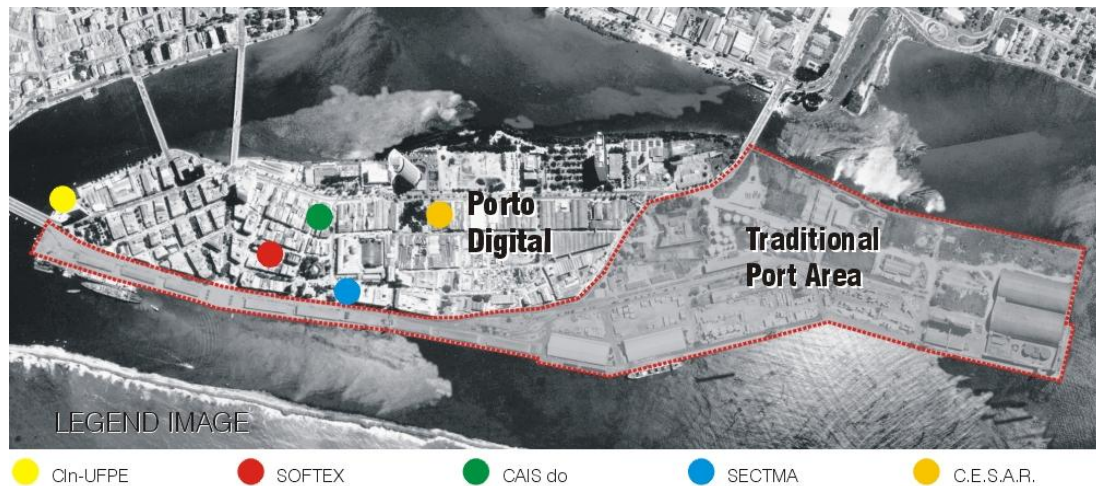
Figure 2: Porto Digital Aerial View

The port area was the financial and business heart of the town until 50 years ago. After the decline of the traditional local economy, heavily based on the sugar cane industry, the area underwent a period of decay and became a rundown and dangerous area of the city. In 1987, 60% of the built environment was obsolete. In the beginning of 2000, nearly 11,000 workers, most from financial and government institutions (the Port itself included), formed community of the island together with only nearly 1,000 low income residents. Therefore, although the area experienced some activity during the day, the place was fairly uninhabited after working hours.

This area was chosen as the territory for Porto Digital for four strategic reasons. First, there was a large supply of low cost buildings that could be redeveloped to host companies and other organizations (200.000 square meters in the year 2000). Second, the city administration had already invested and created incentives to the location of companies in the area. Third, the island is centrally located, being one of the city's prime locations in terms of access. It receives 17% of all metropolitan collective transport lines, and is just about 3,5 miles away from the largest international airport of the Northeast. Finally, the cultural atmosphere provided by the historical roots of the place was considered an asset in the attraction of knowledge based companies.

A major challenge of Porto Digital regarding its territory was to contribute to change the dynamics of this part of the city. First, to significantly increase the number of workers with the employees of ICT companies located in the Park, thus increasing also local commerce and other social activities. Second, to improve the living standards for the low income residents, creating conditions for the establishment of housing for various income groups and different life choices.

To address these challenges is a complex task. The establishment of NGPD was a first step to co-ordinate use-transfer operations in the territory. In particular, the location of the anchor organizations had been conducted under this co-ordination. The second step, carried out by NGPD as well, was the construction of an Urban Development Plan for Porto Digital. This Plan indicates, among other things, "the social, physical and administrative conditions prior to the arrival of Porto Digital, the profile of empty and underused space, the placement of Porto Digital in relation to key investments in the surrounding areas and preferential locations in Bairro do Recife for Porto Digital's direct (ICT businesses, incubators, entrepreneurship training, and start-ups) and indirect (commerce, services, leisure, culture, entertainment) interest functions" (GONÇALVES and REYNALDO, 2002).

Several lessons were learned from the choice of creating the Science Park in the chosen urban area, including:

- a nice location comprised of an island at the sea shore in a historical location is indeed an asset in the attraction of ICT companies

- however, the cost of adaptation of the buildings in such area can be too expensive for private investment alone, requiring public incentives and funding.

- provided adequate finance it is possible to redevelop and adapt the heritage protected buildings to adequately host ICT companies, keeping the historical characteristics of the buildings.

- the synergies between the science park and other urban activities, like shopping centres, restaurants, etc., greatly improve the quality of life in the science park.

The development of the territory is an ongoing and complex process. Several externalities related to the territory are not under direct control of the Science Park, e.g., urban infra-structure of streets, squares, electricity supply, traffic control, security, among others. To improve and maintain such services, the Science Park must keep continuous communication and negotiation channels with the public authorities. NGPD is the organization in charge of this task.

4   A Conceptual Framework

Porto Digital has certain unique characteristics that might be difficult to replicate in other contexts and, on the other hand, account for its differential with respect to other parks. However, several concepts and instruments used to create, develop, and manage the Park are generic, having wider applicability. The generalization of such concepts and instruments lead to a simple yet flexible and powerful framework that can be used to: understand requirements and guide the development of similar projects; inspire policymakers in the definition of local development policies based on innovation; and clarify the roles that a science park can play in such policies.

The framework is organized in three layers as described in Table 2.

Layer	Elements
Policymaking	Linkages, Learning, and Investments.
Innovation System	Institutions, Organizations, and Territory.
Governance	Government, Industry, and University.

Table 2: Layers and Elements of the Framework

The Policymaking layer deals with how to create, stimulate, and strengthen the intangible assets necessary for the innovation process. Policies and instruments must be developed to enhance the way companies and other organizations make decisions and behave related to the following issues:

- **Linkages**: the ways in which enterprises interact with each other and with other organizations (in and outside the local environment) to bring new products and services, new processes, and new forms of organizations to the market.

- **Learning**: how tacit and explicit knowledge flows in the linkages, leading to innovation.

- **Investment**: the destination of available (internal and external) resources towards innovation processes.

For instance, in Porto Digital, the Human Capital Fund (FCH) was created to stimulate companies to invest (*investment*) in the development of a collaborative project (*linkages*) with an educational organization, to internalized new knowledge (*learning*) through training and education.

At the middle layer, the framework adds the local dimension to the institutional and organizational dimensions of the systems of innovation approach (LUNDVALL, 1992; NELSON

and ROSENBERG, 1993). The local innovation system (LIS) is then structured in three dimensions:

- The **institutional framework** of rules, laws, practices, incentives, and funding that shapes the behaviour and expectations of the actors, allowing co-operation and collaboration under the pressures of uncertainty and competition (EDQUIST and JOHNSON, 1997, p. 7; STORPER, 1998, p. 24).

- The **organizational fabric** composed of companies, universities, business incubators, science parks, R&D and innovation centres, government agencies, banks, investors, etc., which, supported by the institutional framework, develop orchestrated actions towards the growth of the local economy.

- The **territory** (location and surrounding environment) regulated by the institutional framework and constantly improved to support the location of companies and organizations.

The development of each dimension should be carried out in such a way that any change in one or more of them taken separately should consider the existence of the other ones. The global objective should be the development of institutions, organizations, and the territory in the direction of consolidating the Local Innovation System, even if a particular movement is done in one single or in pair of dimensions (Figure 3). For instance, at Porto Digital, Municipal Service Tax incentive (*institutional*) was created to make the *territory* more attractive and to enhance competitiveness of local companies (*organizational*) by cost reduction.
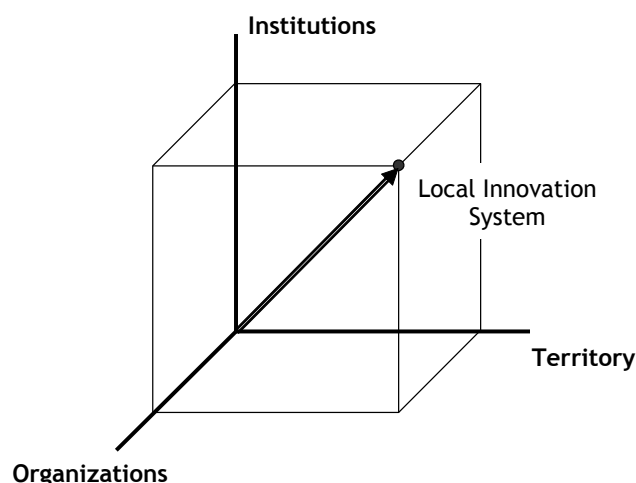

Figure 3: Evolution of the Local Innovation System

Finally, the governance layer supports the development of the LIS in the context of policies and their instruments. Governance builds the political and institutional support for the projects and actions that enhance the LIS and oversees their implementation. This is a complex challenge since it involves diverse and, very often, conflicting interests among actors. To balance these interests, the governance should be built on a Triple Helix model of government-industry-university interaction (ETZKOWITZ and LEYDESDORFF, 2000).

In practical terms, this implies the creation of an organization with a mandate to execute public policies, in which all stakeholders are represented in balanced terms. For instance, in Porto Digital, NGPD is an organization with the mandate for the implementation and operation of the Science Park and the evolution of the local innovation system in ICT. The steering committee of NGPD has a Triple Helix structure with the following composition: 37% government representatives, 21% from the productive sector, 11% from universities, 16% from non-governmental organizations, and 16% from other groups of society.

5 Concluding Remarks

Porto Digital is a science park created to be a major player in the continuous evolution of an institutional framework that support co-operation and competition in a local innovation system of companies and organizations, located in an adequate and constantly improving urban territory. There is a trend worldwide for science, technology, and innovation activities to move to urban areas that are cosmopolitan, culturally rich, and more creative and inspiring. A science park located in such an area will certainly benefit from this trend to enhance its capacity of attracting and supporting world class companies.

One key issue must be observed by those involved in similar projects. The role and nature of the anchor organizations, idealized in early stages of the development of the park, will naturally change over time. These changes must be observed and communicated to all stakeholders. Failure in doing so breaks expectance and undermines trust among companies and organizations, leading inevitably to conflict that can be very harmful for the success of the park.

After the experience at Porto Digital, particularly during the early years of the Existence stage, it is possible to conclude that the success of such endeavour is highly connected to the existence of four pre-conditions:

- A public policy representing the public sector's commitment with the project, which provides political support, long term vision, visibility, institutional instruments, and associated public investment.

- Anchor organizations with distinctive quality, world class competence, and comparative advantages that will drive and support the innovation process.

- A territory for the location of the park, urban or not, with significant local assets that can also be also as attractors of companies to the park.

- The "glue" to bond the previous three pre-conditions together, that is, a leadership component: to define and share a vision of future; to communicate and negotiate widely this vision; and to work hard to implement it.

Rarely these leadership competences are found in one person. The possibility of having different individuals with such level of competence and skills, working together towards a shared desire for creating a better future for all, was one key and decisive factor for the success of Porto Digital.

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