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Article

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RESEARCH

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Science and Technology Parks: laboratories of innovation for urban development - an approach from Brazil

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Abstract

A large part (85%) of Brazil's population lives in urban areas. Roughly half of these dwellers are located in large cities, defined as having 750,000 or more inhabitants. The urbanization trend is due to historical migration movements that occurred mostly before the recent phenomenon of globalization. Nevertheless, the growth of these urban centers is characterized by insufficient public policies capable of ensuring quality of life to its residents. The main assumption of this paper is that large cities may adopt as a strategy the establishment of laboratories of innovation focused on urban development. This effort requires the municipal leadership to organize ways for stimulating the citizens or at least some segments of the population to use creativity and knowledge in order to propose feasible innovative solutions to the serious urban problems they face. In Brazil, Science and Technology Parks (STPs) have assumed the role of laboratories of urban pertinent innovation in several cases. The aim of this research is to study STPs and their possible contribution to sustainable transformation of cities and regions in Brazil, a large, heavily populated and countrywide diverse upper-middle-income economy. The research question is: what makes STPs contribute to improving the quality of urban development? The methodology unfolds according to the following steps: (i) preliminary diagnosis, (ii) learning process - good practice studies; and (iii) feedback - key lessons - revisiting STP models. Based on a review of the Brazilian experience, this article points out that (i) STPs in different parts of the country have been actually functioning as laboratories of innovation that generate solutions applicable to urban development; (ii) as in high-income economies - mainly in the USA, where they originated in the 1950s, STPs in an upper-middle-income economy were capable of rapidly becoming hubs of innovation ecosystems in diverse cities and regions (it should be noted that, with only a few earlier exceptions, the widespread emergence of STPs in Brazil is a phenomenon of the 2000s); and (iii) there is an essential need to use tools that assist STPs in the planning and coordination processes, in order to achieve a level of institutional articulation in the city or region that enables Triple Helix-like innovation ecosystems to lever sustainable urban transformation.

Keywords: Science and Technology Park; Innovation habitat; Urban development; Innovation policy; Regional development

Spanish: Parques científicos y tecnológicos: laboratorios de innovación para el desarrollo urbano. La perspectiva de Brasil.

Resumen: Una gran parte de la población de Brasil (85%) vive en áreas urbanas. Prácticamente la mitad de estos habitantes se localizan en grandes ciudades, entendiendo por éstas aquellas que tienen 750.000 o más habitantes. Esta tendencia urbanística se debe a movimiento migratorios históricos que ocurrieron, en su mayor parte, antes del reciente fenómeno de globalización. Sin embargo, el crecimiento de estos centros urbanos se caracteriza por unas insuficientes políticas públicas que aseguren una mínimo de calidad de vida a los residentes.

La hipótesis principal de este artículo es que las grandes ciudades pueden adoptar estrategias de creación de laboratorios de innovación especializados en desarrollo urbano. Este esfuerzo requiere que los líderes municipales organicen formas de estimular a los ciudadanos o, al menos, a algunos segmentos de la población para que utilicen la creatividad y el conocimiento para proponer soluciones innovadoras a los serios problemas urbanísticos que se están afrontando. En Brasil, los parques científicos y tecnológicos (PCT) ha asumido el papel oportuno de laboratorios de innovación urbana en varias ocasiones. El propósito de esta investigación es estudiar los PCT y su posible contribución a la transformación sostenible de las ciudades y regiones de Brasil, una gran y densamente poblada economía de renta media-alta que se extiende por todo el país. La pregunta de la investigación es: ¿Qué hace que los PCT contribuyan a mejorar la calidad del desarrollo urbano? La metodología sigue los siguientes pasos: (i) diagnóstico preliminar; (ii) proceso de aprendizaje - estudio de buenas prácticas; (iii) retroalimentación - lecciones más importantes - revisión de los modelos de PCT. Basado en el análisis de la experiencia brasileña, este artículo señala que: (i) los PCT en distintos lugares del país han estado funcionando como laboratorios de innovación que han generado soluciones aplicables al desarrollo urbano; (ii) de la misma forma que en economías de altos ingresos –principalmente en los EE.UU., donde estos surgieron en los años cincuenta– los PCT en una economía de ingresos medios y altos son capaces de convertirse rápidamente en el núcleo de ecosistemas de innovación en diversas ciudades y regiones (téngase en cuenta que, con solo algunas excepciones, la emergencia generalizada de PCT en Brasil es un fenómeno que data de la primera década de los 2000); y (iii) existe una necesidad fundamental de emplear herramientas que ayuden a los PCT en los procesos de planificación y coordinación con el fin de lograr un nivel de articulación institucional en la ciudad o región que permita que sistemas de innovación del tipo Triple Hélice logren una transformación urbana sostenible.

French: Les parcs scientifiques et technologiques : des laboratoires d'innovation pour le développement urbain – une approche brésilienne.

Résumé: Une grande partie (85%) de la population du Brésil vit dans les régions urbaines. En gros la moitié des habitants vivent dans des grandes villes, c'est-à-dire de 750.000 habitants ou plus. Cette tendance dans l'urbanisation est due aux mouvements migratoires historiques qui ont eu lieu en grande partie avant le phénomène récent de la globalisation. Néanmoins, la croissance de ces centres urbains est caractérisée par une politique publique insuffisante pour assurer une qualité de vie à ses résidents.

La thèse principale de cet article est que les grandes villes doivent adopter comme stratégie le développement de laboratoires d'innovations portant sur le développement urbain. Ceci demande que les leaders municipaux se donnent les moyens de stimuler les citoyens, ou au moins une partie de la population, pour faire preuve de créativité et de savoir faire dans le but de proposer des solutions innovantes adaptées aux importants défis urbains qu'il convient de relever. Au Brésil, les Parcs Scientifiques et Technologiques (PSTs) ont joué le rôle de laboratoires d'innovations urbaines pertinentes dans plusieurs cas.

Le but de cette recherche est d'étudier les PST ainsi que leurs contributions à la transformation durable des villes et des régions du Brésil, un pays géant, très peuplé et possédant une économie de revenus moyens diversifiée. Il s'agit de savoir dans quelle mesure les PST contribuent à améliorer le développement urbain. La méthodologie consiste en: (i) le diagnostic préliminaire, (ii) le processus d'apprentissage – l'étude des bonnes pratiques; (iii) les évaluations – les leçons-clés – la révision des modèles de PST.

A partir d'une analyse de l'expérience brésilienne, cet article révèle que (i) les PST dans différentes parties du pays fonctionnent en fait comme des laboratoires d'innovation pour générer des solutions applicables au développement urbain; (ii) de même que dans les économies à hauts revenus – majoritairement aux États-Unis, où ils datent des années 50,– les PST dans les économies de revenus moyens sont capables de devenir rapidement des hubs d'écosystèmes d'innovation dans diverses villes et régions (remarquons qu'à quelques exceptions près, l'émergence et la dissémination des PST au Brésil est un phénomène qui date des années 2000); et (iii) il est essentiel d'utiliser les bons outils pour accompagner les PST dans leur processus de planning et de coordination, de manière à atteindre une articulation institutionnelle dans les villes et les régions qui permettent aux écosystèmes d'innovation du type de la Tripe Hélice d'influencer une transformation urbaine durable.

Portuguese: Parques Tecnológicos e da Ciência: laboratório de inovação para o desenvolvimento urbano – uma abordagem do Brasil.

Resumo: Uma grande parte (85%) da população do Brasil vive nas áreas urbanas. De modo grosseiro, metade de seus habitantes está localizada nas grandes cidades, definidas como tendo 750 mil ou mais habitantes. A tendência de urbanização se deve aos movimentos migratórios históricos, que ocorreram em sua maioria antes do recente fenômeno da globalização. Todavia, o crescimento desses centros urbanos é caracterizado pela insuficiência da política pública na capacidade em assegurar a qualidade de vida para seus residentes.

A suposição principal deste artigo é que as grandes cidades devem adotar como estratégia o estabelecimento de laboratórios de inovação baseados no desenvolvimento urbano. Esse esforço demanda das autoridades municipais organizar formas de estimular seus cidadãos, ou ao menos alguns segmentos da população, à usar a criatividade e conhecimentos para propor soluções inativeis realizáveis para os sérios problemas urbanos enfrentados. No Brasil, Parques Tecnológicos e Científicos (PTCs) tem assumido a função de laboratórios para inovações urbanas pertinentes em muitos casos,

O objetivo desta pesquisa é estudar os PTCs e suas possibilidades de contribuição nas transformações sustentáveis de cidades e regiões do Brasil, um grande e populoso com uma economia nacional de renda média-alta diversificada. A pergunta do estudo é: O que faz os PTSs contribuírem para o melhoramento da qualidade do desenvolvimento urbano? A metodologia é desenvolvida de acordo com os seguintes passos: (i) Diagnóstico preliminar, (ii) o processo de aprendizado – estudo das boas práticas; (iii) feedback – lições chave – voltando a visitar os modelos PTSs. Com base na revisão da experiência brasileira, esse artigo destaca (i) que os PTSs nas diferentes partes do país têm na verdade funcionado como laboratórios de inovação para produzir soluções aplicáveis ao desenvolvimento urbano. (ii) Assim como nas economias de renda alta – em especial nos Estados Unidos, onde foram originados na década de 50, os PTS em uma economia de renda media-alta são capazes de se tornar rapidamente conglomerados de ecossistemas de inovação em diversas cidades e regiões (isso deve ser notado que salvo algumas exceções, a grande propagação dos PTCs é um fenômeno dos anos 2000); e (iii) existe uma necessidade essencial de utilizar ferramentas de suporte aos PTSs no processo de planejamento et coordenação afim de atingir o nível de articulação institucional nas cidades e regiões que permita o desenvolvimento de ecossistemas de inovação como os de Hélice Tríplice, para alavancar a transformação urbana sustentável.

Chinese: 科技园:旨在城区发展的创新实验室 - 巴西途径

摘要: 巴西人口的很大一部分(85%)生活在城市地区。大约有一半的居民都住在被定义为有75万以上居民的大城市。城市化趋势是由于主要发生在近期全球化现象之前的历史迁徙运动。然而,这些城市中心的增长有个特征,即缺乏能确保其居民生活质量的公共政策。

本文的主要假设是大城市可以采取一种策略:建立创新实验室,聚焦于城市发展。这项工作要求市领导想方设法刺激公民,或者至少某些公民,利用创意和知识提出可行的创新解决方案,解决他们所面临的严重城市问题。在巴西,在若干情况下科技园(STPs)被假定起着城区相关创新实验室的作用。

巴西是个大的、人口稠密的、整个国家收入不均衡的中上等收入经济体。这项研究旨在研究在巴西的科技园及其对所在城市和区域可持续转型的贡献。所研究的问题是:什么让科技园对提高城区发展的质量有所贡献?在方法上按照以下步骤展开:(1)初步诊断;(2)学习过程,即深入的实际调查研究;(3)反馈,即找出重要的经验教训,重温科技园模式。

基于对巴西经验所进行的审查,本文指出:(i)在巴西不同地区的科技园实际上已经起到创新实验室的作用,生成了适用于城市发展的解决方案;(ii)如同在高收入经济体那样 - 主要是科技园在20世纪50年代诞生的美国,在上中等收入经济体的科技园有能力迅速成为在不同城市和区域创新生态系统的枢纽(应当指出的是:除少数几个早期科技园外巴西的科技园普遍出现在21世纪);(iii)有必要在规划和协调过程中利用工具帮助科技园,以实现一个城市或区域的机构衔接水平,使三螺旋能像生态系统那样促进可持续的城市转型。

Russian: Научные и технологические парки: лаборатории инноваций для городского развития на примере Бразилии

Аннотация: Значительную часть (85%) населения Бразилии составляют жители городских округов. Около половины из них проживают в крупных городах, насчитывающих более 750 тысяч человек. Тенденция урбанизации основана на исторических миграционных потоках, которые сформировались намного раньше современного феномена урбанизации. Тем не менее, рост урбанистических центров характеризуется недостаточностью общественных инициатив в сфере обеспечения надлежащего качества жизни их резидентов.

Основным допущением настоящей работы является то, что крупные города могут принимать в качестве стратегии возможность создания инновационных лабораторий, специализирующихся на развитии городов. Данное усилие требует инициатив местных муниципалитетов в создании путей стимулирования жителей, или их отдельных групп, к использованию креативности и знаний для поиска возможных инновационных решений серьезных проблем города, с которыми они сталкиваются. В Бразилии научные и технологические парки (STPs) в ряде случаев приняли на себя функцию городских инновационных лабораторий.

Целью настоящего исследования является изучение STPs и их возможного вклада в устойчивую трансформацию городов и регионов Бразилии, большой страны с высокой численностью населения и диверсифицированной экономикой с уровнем доходов выше среднего. Вопрос настоящего исследования: за счет чего становится возможным улучшение качества городского развития при участии STPs? Методология исследования включает следующие шаги: (i) предварительная диагностика, (ii) познавательный процесс – изучение наилучших практик; (iii) обратная связь – ключевые выводы – пересмотр моделей STP.

Multilingual abstract

Please see Additional file 1 for translation of the abstract into Arabic.

Introduction

According to the World Bank classification, Brazil is an upper-middle-income economy^a. Outstanding geographical characteristics are size and population, both among the world's highest, making the country a member of the so-called BRICS^b. Among its peers, Brazil has the largest proportion of the population (85%) living in urban areas, with roughly half of these dwellers located in large cities, defined as having 750,000 or more inhabitants.

The urbanization trend is due to historical migration movements that occurred mostly before the recent phenomenon of globalization. A main trigger of urbanization was the successful process of rapid industrialization that began in the mid-1950s, powered by an active public policy of substituting imports by locally manufactured products. An unforeseen consequence of this policy was the spontaneous attraction of millions of unskilled peasants by cities and metropolitan areas with new booming industries, such as the automotive cluster in Greater São Paulo. As no city was minimally prepared for such a massive influx of population, major urban problems arose and, in many cases, remain until present times.

In fact, the growth of these urban centers in Brazil is characterized by hypo-sufficiency of public policies capable of ensuring quality of life for their inhabitants, including critical aspects such as urban mobility, quality of housing, job opportunities and income, culture, and environment (Martine and McGranahan 2010). Indeed, according to the *City Prosperity Index* developed by the United Nations Human Settlements Programme^c, Brazil's most populated metropolitan area (São Paulo) ranks below its parallels in Russia (Moscow) and China (Shanghai), but above its equivalents in India (Mumbai) and South Africa (Johannesburg).

This article addresses the topic of Science and Technology Parks (STPs) as laboratories of innovation, serving as tools for urban transformation in Brazil,

Presuppositions

The main presuppositions for this paper, all referred to the Brazilian context, are the following:

- a) The expansion of urbanization comprises not only the growth of large cities and metropolitan regions but also the densification of urban networks by means of strengthening medium size cities located near these regions;
- b) The installation of industries in cities located near large urban centers responds to a need to find sites that offer lower costs for carrying out their activities; such a logistics strategy fosters a demand for new alternatives to quality investments, formation of specialized human capital, and mechanisms to access knowledge (e.g., technology transfer);
- c) The Brazilian context is consistent with global aspects of urban development, i.e., a tendency towards an increasing proportion of urban population, associated with growing concerns regarding the consequences of disturbances in the planet's ecosystems;
- d) Municipalities and state governments (the latter are legally responsible for the metropolitan areas) take part in the establishment and management of STPs, with the intention of making them laboratories of innovation relevant to urban

development; the successful endeavors help to overcome the degradation of urban areas and stimulate the creation of smart solutions for diverse urban problems among different constituencies (students, start-ups, NGOs, and/or others). The concrete results of such process of turning knowledge into urban applicable solutions may benefit cities and regions beyond the one that generated them;

- e) STPs contribute to sustainable urban development not only by attracting, coaching, and hosting developers of smart solutions but also by articulating and then becoming hubs of regional innovation systems;
- f) National and local public authorities formulate policies and implement programs to speed up business innovation based on technological and managerial knowledge, including, but not limited to, the creation of innovative companies, assisted by business incubators and accelerators;
- g) Public policies that stimulate STPs favor cross-fertilization between innovative firms and other actors of the innovation ecosystems, such as universities and research institutions. It is the authors' experience that STPs are often important components of Triple Helix-type environments (Zouain and Plonski 2006).
- h) Technical literature highlights the involvement of the regional/local public sector through organizational structures, legal mechanisms, tax benefits, articulation practices, and attraction of knowledge-based business. STPs conceived with this systemic characteristic have been branded *third-generation STPs* (Allen 2007; ANPROTEC 2008), an approach that will be expanded further along this article. Established STPs of former generations, e.g., focused on real estate and facilities management, have been also encouraged to 'upgrade,' by pivoting their mission, vision, and agenda.

Goal

The aim of this paper is to study models of Brazilian innovation habitats, in particular STPs, and understand their contribution to sustainable transformations of major cities and regions.

Research question

What makes STPs contribute to improving the quality of urban development?

Methodology

The methodology adopted in this study is based on participatory research - action learning. Previous academic study and practical involvement of the authors in planning innovation habitats in Brazil, including STPs, were an important consideration in the choice of the methodology. The research followed three steps: (i) preliminary diagnosis - research on secondary data, literature review; (ii) learning process - by technical discussions among the authors and good practice studies (observation); and (iii) feedback/reflection - revisiting the STP models - lessons from urban STP design and management in Brazil.

Preliminary diagnosis - literature review

The literature review was conducted according to the two *research vectors*, namely innovation habitats (mainly STPs) and urban regions as dynamic spaces (specifically

the contribution of STPs for urban transformation). The conceptual framework was designed taking into account the following references and authors:

Innovation habitats - Science and Technology Parks

The definition provided by the International Association of Science Parks and Areas of Innovation - IASP (2014) encompasses all relevant aspects^d.

It is also important to understand the challenges to be faced by STPs in the near future, as in the study centered in high-income economies presented in the *Battelle Technology Partnership Practice*, in cooperation with the (BATTELLE 2007). That case study of North American Research Parks portrays their insertion and role in regional and urban development.

Given the economic and market aspects of STP performance, Martins (1997) points to their nature and scope as important players on the globalized economy stage. Finally, the following texts were examined, in order to understand the Brazilian scenario of innovation habitats - namely STPs and business incubators:

- *ANPROTEC* (2008) - this study deals with Science and Technology Parks' generations and models and with STPs' development in Brazil, providing an analysis and public policies' propositions;
- *Bouchardet* (2012) - this book deals with STPs in Brazil as important tools for regional and urban development and describes, among others, parks in four state capitals - Rio de Janeiro, Recife, Florianópolis, and Porto Alegre;
- *Zouain et al.* (2014) - this paper provides a reference methodology for establishing science, technology, and innovation strategies for technology park projects submitted to the São Paulo State Technology Parks System;
- *Zouain et al.* (2007) - this paper aims to propose STPs as important tools for urban development and analyses their contribution to public policies for local sustainable development; and
- *Zouain* (2003) and *Zouain and Plonski* (2002) - the paper and the doctoral dissertation present a proposal for a conceptual model of STPs for urban and metropolitan regions and analyze a case in the city of São Paulo.

Urban regions as dynamic spaces - the contribution of innovation habitats for revisiting/reconstructing urban regions and seeking more creative solutions

Can STPs be tools for urban requalification of degraded areas? In order to answer this question, the following references were studied:

- *Silva and Silva* (2006) discuss and offer some suggestions about renovation of degraded and depressed areas in the context of the knowledge society;
- *Hauser et al.* (2005) develop the idea of STP models as tools for urban requalification of degraded areas, pointing to some international experiences;
- *(Barcelona Urban 2014)* provides important contributions about STPs as environments for testing solutions to face urban development challenges - mainly the case that also became the document's name; and

- *Lapa and Melo* (2007) analyze the development of the Porto Digital project, facing the urban challenges and local policies for requalification of degraded and depressed areas in the city of Recife, capital of Pernambuco.

Finally, in order to better understand the history of urbanization in Brazil and urban development policies, the authors of the present article got inspiration in Martine and McGranahan (2010).

Recent evolutions of the concept of Science and Technology Parks

As mentioned earlier, Allen (2007) highlights which characteristics a future, successful, and mature STP should have in order to be considered as belonging to the *third generation*:

- '*A global player, but with local roots*' - Tenants see no boundaries to their commercial activities and seek strong international presence. Therefore, a STP should seek to strengthen its brand and the visibility of the city and region in which it is inserted.
- '*A part of the community, with care for people and the environment*' - Architectural and urban designs of STPs take into account not only the quality of space for corporate activities and conviviality of their members but also the quality of life of neighboring communities, together with a strong commitment to environmental sustainability.
- '*A healthy business and an opportunity for investment*' - The management team of a STP should seek financial sustainability, prioritizing efforts to attract private investment. With regard to tenants, it is important to provide support for accessing capital for investment in their projects. Therefore, the STP must count on a specialized team of professionals and a chief executive with leadership skills.
- '*An essential element of university activity*' - The STP should be closely integrated to academic activities of universities and research centers that are its anchors of knowledge. Tenants should influence the design of undergraduate courses, research themes, and topics of graduate courses.
- '*Part of a multiplicity of networks*' - Connectivity and network activity are essential to ensure the success of the STP and its companies. Networks should be established at the local, regional, and international levels, providing tenants access to knowledge and business opportunities.
- '*Focused on the needs of its tenants*' - The management team of the STP should develop a trusting relationship with the company in order to create real opportunities for business development and an environment of healthy collaboration.

The trend of STP models more integrated into local/regional sustainable development processes is underscored by Sanz (2001) - who is the IASP's Executive Director. In his point of view, evolution of the STP model into *learning villages* comprises businesses, educational centers, and residential areas; their most important infrastructure is based on information technology. This evolution got a new impulse since 2012, when the Association expanded its scope (and name) from STPs to 'STPs and Areas of Innovation.' In the 31st IASP Conference, held in October 2014, Sanz presented a

sketchy analysis of these ‘new animals,’ based on the analysis of ten members of the Association, including Porto Digital, one of the cases described in this paper. He also underscored the tendency to evolve from greenfields to brownfields as the location for newcomers.

The notion of *sustainable competitiveness* argued by Martins (1997) can be added to this perspective, as the challenges and opportunities in current markets and the trends of modern societies cause dynamic changes in the structure of business. In fact, new generations of entrepreneurs are coming up with more comprehensive and systematic views of environmental issues and their consequences for the survival and success of business. This author believes that STPs bring quality solutions that consider aspects of this kind of the multidimensional concept of sustainability, as well as offer excellent facilities for stimulating the exchange of relevant information, encouraging an atmosphere of cooperation, and cross-fertilization. This is essential for the coexistence of companies that deal with the uncertainties of technological business.

The emblematic case of Spanish STPs is analyzed in the context of the *milieu* theory of as an agent of innovation by Ondategui (2001), citing the work of Castells (1992). The authors consider, in this sense, STPs as planned by different types of stakeholders, aimed at high-tech sectors, involving new types of productive areas. Thus, these new spaces of technological innovation are characterized by a kind of flexible and specialized production, by a high economic dynamism, allowing the emergence of new models of local and regional development.

In the context of the Spanish case, and of interest of this study, the present article highlights the Barcelona project called *Poblenou - District 22 @ BCN*, a particularly interesting requalification of depressed urban areas. It is considered a new approach to thinking and changing the city, adapted to the information society. It has a focus on information technology and communication industries and is inserted in the concept of *knowledge city*, i.e., a sustainable city from the environmental point of view. Based on a new development model, rational and consistent, it proposes the optimization of the exchange of knowledge and experiences that enrich urban ecosystems. It also provides people with a better quality of life, making them more qualified and integrated into the system and providing competitiveness to the territory (Silva and Silva 2006).

The *Barcelona Urban Lab (BUL)* should be mentioned in the above-mentioned context. The 22@Barcelona municipal company is responsible for consolidating Barcelona's role as an innovative city. *BUL* was created as a specific line of action to foster use of the city as an urban laboratory. Through this project, the city is made available to companies with innovative projects to test their infrastructures and services for the future in a real environment. The definition of Urban Lab by Barcelona Urban Lab (2014) is: ‘...a tool to facilitate the use of public spaces in the city of Barcelona to carry out tests and pilot programs on products and services with an urban impact, which are in the pre-market stage and in line with the Barcelona City Council's aims, priorities and lines of action.’

In Brazil, several of the STP projects were designed from a perspective of urban development and requalification, since the urban centers in the country are characterized by the transition between the production model of industrial society and the urban model of the information society. Indeed, Martine and McGranahan (2010) highlight a massive and rapid urban growth in Brazil, with absolute lack of public policies to

deal with this phenomenon, which has greatly impacted the populations of large cities, especially regarding the lack of leisure, cultural facilities, employment, and income opportunities, as well as housing, i.e., quality of life.

These repressed tension exploded in June 2013, only 3 years after the above-mentioned publication, triggered by the announcement of a small increase in public transportation charges (the increase was 20 centavos of a real, equivalent to 8 US dollar cents). A chain of urban revolts took over several of Brazil's major cities centers. They brought to the streets an odd combination of middle class (including public servants), squatters and hooligans, led by university students. The mottos of the manifestations were 'It is not about the 20 centavos' and 'We want (health, transportation, housing...) according to FIFA standards,' alluding to the unusual high quality of the infrastructure that was being built at that time to serve for the following year's World Cup, conforming to the strict high-level quality requirements included in the contract signed between Brazil's Federal Government and the International Federation of Soccer Association (the acronym in Portuguese is FIFA).

Hauser et al. (2005) highlight this framework in which, lacking clear intervention of public administration, cities grow without control, mainly through peripheral occupations. Meanwhile, other centralities arise, caused by the new means of production (typical of the knowledge society), resulting in evasion of areas previously occupied, especially in the case of city centers. This situation is clear in large urban centers, among others, in the cases of Recife (Pernambuco State capital), Porto Alegre (Rio Grande do Sul State capital), São Paulo, and Rio de Janeiro (respectively, capitals of the states with the same name).

The ANPROTEC^e (2008) study, commissioned by the Brazilian Association for Industrial Development and the Ministry of Science and Technology, points to a set of challenges to be faced by the Brazilian STP projects. Comparing the key findings of the survey prepared by Battelle Technology Partnership Practice in cooperation with the (BATTELLE 2007), it can be seen that, although recognizing the vast North American experience in STPs, some challenges of these innovation habitats are similar in both studies, as shown in Table 1.

The innovative entrepreneurship in Brazil has grown significantly in recent decades, with important participation of the innovation habitats in the development and economy of Brazilian regions. In the University of Brasília CDT/UnB (2013) study, commissioned by the Ministry of Science, Technology and Innovation, the updated data of this movement are pointed out (Table 2).

Learning process and good practice studies

Practices of five STPs in highly dense urban centers with degraded and depressed areas were studied, focusing on the socio-economic and environmental aspects: Porto Digital (Recife), Rio Science Park (Rio de Janeiro), Sapiens Technology Park (Florianópolis), Tecnopuc (Porto Alegre), all of them in operation, and the São Paulo Technology Park Project (São Paulo), still in implementation. These parks are located in different states, covering three (Northeast, Southeast, and South) of the five country's macro-regions.

Secondary data from the following references were used: Bouchardet (2012), Zouain et al. (2014), Zouain et al. (2007), Zouain (2003), Zouain and Plonski (2002), and Lapa

Table 1 Challenges to be faced by Brazilian and North American STPs

Brazilian STPs - challenges	North American STPs - challenges
Lack of positioning strategy and vision of future.	Overcoming commercialization challenges - to provide support services to ease the commercialization process.
Heavy reliance on public funds.	
Limited experience in real estate and financial areas.	
Difficulty of effective engagement of academic leaders.	Bridging cultural barriers between the academic and business communities and facilitating true partnership. Achieve greater integration with the university.
Need to articulate regional and national actions to prevent a 'bubble' of isolated initiatives with little chance of success and remarkable results.	
Difficulty in tuning the implementation strategy of technology parks with regional and national priorities, as well as with international trends.	
Need for significant financial funds to 'make a difference' in the global market and, at the same time, clear rules for intensive attraction of private equity	Obtaining funding for operations and buildings - the need for capital becomes even greater as research parks try to implement live-work-play models. Responding to increased competition owing to globalization and the changing nature of corporate R&D - the challenge to attract operations of foreign companies and to retain the R&D operations of US companies.
Lack of a national policy for STPs clearly establishing the role of various players: Federal Government, State Government/Region, Municipal Government/Local, universities, private sector, financial sector.	

Source: Adapted from ANPROTEC (2008) and Battelle (2007).

and Melo (2007). The brief description of each case was enriched by qualitative elements derived from following up closely the evolution of these initiatives almost since their inception. In the São Paulo case, the present authors contributed to its conception and to some of the implementation efforts.

The following research vectors were focused: (i) history and local/regional impact, management model and real state strategy, (ii) vocation, and (iii) future perspectives and strategies. The main results are presented below.

Table 2 Business incubators and STPs in Brazil

	Data
Business incubators	384 business incubators 2,640 incubated companies 2,509 graduated companies 1,124 associated companies 16,934 jobs in incubated and associated companies 29,905 jobs in graduated companies US\$ 266 million in yearly revenues from incubated companies US\$ 2 billion in yearly revenues from graduated companies
Science and Technology Parks	94 STP initiatives 28 parks in operation 939 companies in operation 32,237 jobs created so far (the vast majority of the operating parks was less than 10 years old)

Source: Adapted from the data in the CDT/UnB (2013).

Porto digital (in operation)***History and local/regional impact***

The Recife STP is the result of a movement, initiated decades ago by then young idealistic academic faculty, to create a knowledge-based model for the development of the Northeast, the poorest region in the country. The original model, based on Federal public policies that stimulated the establishment of large manufacturing companies that relied on a combination of cheap labor and hefty tax benefits, had been only partially successful and was discontinued because of endemic high levels of corruption in the process of granting subsidies.

Among other academic new courses, an excellent program in computer sciences began operating in the Pernambuco Federal University main campus, located in Recife, the state capital. However, to the dismay of its founders, a sizable part of the computer science graduates did not establish themselves in Recife or elsewhere in the Northeast, but were immediately hired by major IT companies established in the richer Southeast or went abroad, recruited by known multinational IT firms. A survey showed that the reason for the high rate of early brain drain, which would frustrate the advance of the knowledge-based development model sought, was neither lack of employment opportunities nor insufficient natural and cultural attractions in Recife, but the absence of creative professional challenges in the local and regional market. In order to revert this process, the computer science academic leadership established a software-focused business incubator and went out on a marketing-style campaign to get contracts to the new ventures involving the development of innovative software-based solutions to challenging problems posed by interesting clients located elsewhere.

The success of the incubator strategy and the political savvy of the mission-imbued academic faculty engendered a singular opportunity to create a focused STP in Recife. A sizable amount of the resources generated by the privatization of a public service company was allocated by the State of Pernambuco government, on the condition that, instead of investing in the proposed glitzy new building on campus, the project would be installed in the completely degraded Old Port area, taking into consideration historical, environmental, and social requirements. In summary, it should serve also as an emblematic innovative urban retrofitting model.

Porto Digital (the name means *Digital Port* in English) was inaugurated in 2000 with the goal of creating, in a historic, albeit deteriorated and depressed area of Recife, a pole of development based on world class software industry. That completely degraded part of the city is now revitalized, both in physical and in socio-cultural dimensions, as a result of the actions of Porto Digital. The strategy of installing a brownfield STP in that area of the city has generated good results, allowed the requalification of the historical space, and provided a new economic reality to the city. From the economic perspective, Porto Digital's contribution peaked 3.5% of the Pernambuco State Gross Product in just a few years of operation.

The social responsibility of the Porto Digital leadership also manifested itself in helping to modernize the state traditional small and medium industrial clusters, located in other parts of Pernambuco. This initiative has been thoughtfully named 'The Port disembarks.'

Management model and real estate strategy

The STP is managed by the Porto Digital Management Center, which is qualified by the State of Pernambuco Government as a 'social organization'⁴. The Center has a Board of Directors composed of members of public and private organizations. The management team consists of a president, an executive director, and a director of innovation and business competitiveness.

The STP was responsible for the redevelopment of over 40,000 m² of historic buildings, mostly now occupied by software and related companies, articulating owners of rental properties and contractors. Porto Digital also develops real estate financial operations in order to recover ruined buildings, covered by the strict historical heritage regulations, for occupancy by businesses.

Vocation, future perspectives, and strategies

Porto Digital's vocation comprises (i) software and services for information technology and communication and (ii) creative economy, especially games, multimedia, movie-video-animation, music, and design.

The STP strategic planning for a horizon of 10 years envisions, as the main goal, to employ about 20,000 qualified people in at least 400 innovative endeavors. For this purpose, Porto Digital carries on 37 projects developed in 6 axes, namely attract new investment and strengthen resident companies, further integrate Porto Digital with other economic sectors of the State of Pernambuco, increase actions at the national and international level, reinforce the brand and reputation of the STP, intensify social responsibility actions and digital inclusion, and fortify governance and technical capacity of the STP management team.

The Rio Science Park (in operation)

History and local/regional impact

The design of the Rio Science Park was based on the experience of the successful business incubator installed in the main premises of the Federal University of Rio de Janeiro (the acronym in Portuguese is UFRJ), one of the leading academic institutions in the country. Connection between science and business R&D is imbedded in UFRJ's ethos, making a sizable part of the academic community feel comfortable with the Triple Helix concept. UFRJ's innovation habitat leadership was also responsible for pioneering the model of Popular Cooperatives Technological Incubator, replicated in other Brazilian universities. This practice focuses on stimulating and providing incubator-style support and self-organization skills for new low-tech business created by residents of neighboring slums, as an alternative to traditional employment, self-employment, or unemployment.

The main campus is located in the Fundação Island, close to Rio de Janeiro's international airport, an environmentally degraded area, with a high amount of slums. The University authorities allocated 350,000 m², equivalent to 8% of the campus area, to the STP project, approved in 1997. Urbanization infrastructure works were complex, due to its location in an area susceptible to flooding and difficult to drain. Therefore, the Rio Science Park was only dedicated in 2003, together with the Laboratory of Ocean Technology.

This large facility became another milestone in the research of deep water technologies, a field in which Brazil excels (Petrobras, the major Brazilian oil and gas concern, has been repeatedly awarded coveted international prizes in offshore exploration). The subjacent reason is an iconic Triple Helix case - a close-knitted network involving: (i) three complementary laboratory facilities in three different institutions - UFRJ, University of São Paulo (USP), and the São Paulo State Technological Research Institute; (ii) a key large sophisticated user (Petrobras); (iii) legal requirements for significant R&D investment by oil producers, strictly enforced by the National Oil, Gas and Biofuels Regulatory Agency; and (iv) strong financial support for R&D and innovation projects in this field by government funding agencies.

The Rio Science Park achieved wide impact in its first 10 years of operation:

- The STP, located in an until recently deteriorated swampy area, now contributes effectively to a greater visibility of Rio de Janeiro's technological vocation; the Park is widely recognized as an important element in the revival of the city, affected by decades of economic and social decadence;
- Research and Development centers established in the Park by world class multinational companies such as Schlumberger, Baker Hughes, FMC Technologies, Usiminas, Halliburton, Tenaris Confab, BG, EMC, Siemens, and GE joined an existing set of R&D public and semi-public preexisting technology and innovation hubs based around UFRJ's campus, mainly Cepel (Electrical Energy Research Center), Cenpes (Petrobras Oil & Gas Research Center), and Fiocruz (National Health Research Center).

Management model and real estate strategy

Rio Science Park is a public initiative that belongs to the UFRJ. The governance system includes a Board of Directors with representatives from public and private regional entities, which elects the STP Director, necessarily a University employee.

Administrative management is performed through a private not-for-profit foundation, created some decades ago in order to manage contracts related to university-industry and university-government cooperation.

The real estate strategy of the Rio STP is straightforward: land is sold to companies through public competition, in the highest bid modality. It is worthwhile mentioning the lengthy process of overcoming legal restraints to the use of public land for private purposes.

Vocation, future perspectives, and strategies

Rio Science Park has a multi-sector vocation, with emphasis in the areas of energy (mainly oil and gas), environment, and information technology.

As the original area is in complete use, expansion plans for the Rio Science Park include a new area located on the campus known as Bom Jesus Island.

Sapiens Technology Park (in operation)

History and local/regional impact

Sapiens Park was conceived in 2001, following the success of the innovation ecosystem of Florianópolis, the capital of Santa Catarina State. The STP was designed to be a large

space (4.3 million m²) dedicated to installing innovative businesses in an environmentally sustainable way, providing the region with social, economic, and environmental development and expanding the actions of the local innovation system.

Bouchardet (2012) presents impressive numbers for the Florianópolis local innovation system, namely 550 technology-based companies, 3 technology parks, 6 incubator centers, 15 universities, 8 research centers, 7 entrepreneur complexes for technology companies, and 3 hospitals performing in clinical research. Sapiens Park can therefore be characterized as a regional development program, creating a new urban center, based on the knowledge economy.

The nucleus of the impressive transformation of a city located on an island formerly famous mostly as a paradisiac summer resort, because of its beaches, in a national hi-tech innovation powerhouse is due to a private non-for-profit academic research organization (Fundação Certi). Created by then young faculty of the engineering tracks at the Santa Catarina Federal University and headquartered in the Florianópolis main campus, a relevant aim of Certi was to create innovation habitats for the graduates in electrical and mechanical engineering who, at the time, had to leave the capital in order to find employment in other parts of the State, as the environmental rulings did not allow the installation of industries. Certi became the hub and manager of one of the first Brazilian business incubators and STPs, both created in the late 1980s. By the end of the 1990s, a strategic plan was articulated by multiple social actors, around the idea of making Florianópolis a reference as a knowledge city, albeit maintaining the quality of life necessary to continue being a desirable tourism destination. By the year 2007, the contribution of IT companies cultivated in city innovation habitats surpassed the tourism industry.

Management model real estate strategy

The management of the STP is performed by Sapiens Park S/A, a closed capital corporation, controlled by the Government of the Santa Catarina State, through SCPar (a public company) and Codesc (a joint stock company). Sapiens Park S/A units of land must be negotiated through public operations.

Real estate strategy: the modules of Sapiens Park are treated like private ventures, whose development takes place by the real estate market through sale or exchange of land by built-up areas. Other ways to provide areas for innovative companies are also possible, including rental areas, exchange for built-up areas, and use of surface rights (Gargione 2011).

Vocation, future perspectives, and strategies

The STP vocation comprises information technology and communications, mechatronics, life sciences, sustainable energy, and creative economy.

Sapiens Park, as a whole, is a long-term undertaking. A major concern for the success of the project lies in the infrastructure of the region where it operates, particularly with regard to roadway system, energy supply, sanitation, communication, urban mobility, and strategic equipment (airport, convention center, hotel chain).

Tecnopuc (in operation)

History and local/regional impact

The idea to create *Tecnopuc* emerged at the Pontifical Catholic University of Rio Grande do Sul (the acronym in Portuguese is PUCRS), in order to capitalize on its

strong performance in research and the vast array of projects conducted with private companies. It was triggered by the enthusiastic feedback given by a faculty member of the information technology track, after participating, in representation of the institution, at the II National Conference on Science, Technology and Innovation, in 2001,, which was a watershed for putting innovation into the Brazilian public and private agendas.

The STP, known by the acronym Tecnopuc, is situated in the University campus, in the center of Porto Alegre, a city with more than 1.5 million inhabitants that is an important economic center in the southern region of the country. One of the goals of Tecnopuc is to consolidate a cooperation network that contributes to promoting scientific and technological development of the city, under the umbrella of the Porto Alegre Technopole Project.

The initial contribution of Tecnopuc to the urban tissue of Porto Alegre was the retrofitting of a military installation nearby the campus that was being decommissioned, to rapidly serve as the first physical base of the STP.

Management model and real estate strategy

Tecnopuc is a unit of PUCRS, managed by a steering committee composed of the Vice-rector for Extension and Community Affairs, the Vice-rector for Research, Innovation and Development, the Director of the Technological Management Agency, and the Coordinator of the Legal Department.

Vocation, future perspectives, and strategies

The original vocation of Tecnopuc, Information and Communication Technology, expanded and now includes electro-electronics, energy and the environment, biological and health sciences, biotechnology, and creative industry.

The future vision adopted by the STP is to become a national and international reference, to enhance the relevance of the University research groups through their involvement in innovation, and to promote the technical, economic, and social development of the Porto Alegre metropolitan region.

In 2004, Tecnopuc expanded its operations into a new area in a nearby city, called Viamão campus, focusing primarily on the segment of the creative industry. Its future vision also includes planning and implementing Global Tecnopuc - a center of innovation, creativity and networking, targeting hosting cooperative research centers (open innovation model), as well as companies focused on the global market.

The São Paulo Technology Park (under construction)

History and local/regional impact

São Paulo is the most cosmopolitan and modern of all Brazilian states. With 21% of Brazil's population, it generates a third of the country's industrial production, has a third of the commerce, and creates half of the R&D. The GDP per capita is 50% higher than the national average. More than 20 million of the state's 42.7 million inhabitants live in the metropolitan area of the city of São Paulo.

The *São Paulo Technology Park* model takes advantage of the University of São Paulo's (USP) structure and of the research institutes surrounding the main campus in

the city of São Paulo. USP is Latin America's top institution the main global universities rankings.

The goals of the project are (i) to accommodate companies engaged in the commercial application of S&T&I, creating a cross-fertilization environment; (ii) to develop activities including R&D, innovative processes, production, sales, and services; (iii) to stimulate quality gains and competitiveness in the productive process of the small- and medium-size companies in the region; (iv) to contribute to regional development of public policies/(v) the recovery of degraded areas of the city, by generating a healthy urban movement; (vi) to attract new business in modern productive sectors by establishing an international network of cooperation; and (vi) to promote social and cultural development of the region by mobilizing the local community and government and private organizations, engaging multiple interest groups.

Management model real and real estate strategy

The STP was designed in two phases. The first one is currently being implemented inside the USP campus and in an area next to it, owned by the State of São Paulo Government. A building to host the core operations, facilities for small companies, and offices for other activities associated with the services to be offered by the technology park was dedicated in July 2014 but has yet to enter operation.

This first phase aggregates Cietec - a private non-for-profit civil association that manages the technology-intensive business incubator center in the campus since its inception, in 1997. This management comprises pre-incubation activities and resident companies and also support to non-resident mature small tech business, according to the 'incubator without walls' concept.

The model proposed will create an accelerator program for startup companies - focus on small teams and groups of startups, to be established in the metropolitan region, offering time-limited support comprising programmed meetings, and intensive mentoring. As several accelerators were recently established in São Paulo, two value-added proposals are being devised: (i) focusing on USP students and graduates, in a context where grassroots entrepreneurship movements are booming in the campus, and (ii) establish a hub for a metropolitan wide network of accelerators, due to the direct connection of this STP to the State Government.

The second phase of this STP is related to its spreading in the urban areas around the University campus. It is expected that innovation clusters of technology-based companies will be associated to the Park, in order to benefit from the new infrastructure and the services provided.

Vocation, future perspectives, and strategies

The vocation of this STP includes information technology, nanobiotechnology, and biological pharmaceuticals.

A key challenge for the project is to consolidate the partnership with the São Paulo Municipality, which has the power to establish zoning and construction allowances that are crucial for the effort to embed the Park in the urban fabric. This is needed mainly with the aim of establishing favorable conditions to stimulate the attraction of businesses to the region surrounding USP's campus, changing its characteristics of degraded and depressed area, including several slums.

Other challenges include (i) developing a partnership model for attracting the private sector for the development of phase 2 of the STP, therefore combining private and public real estate initiatives, and (ii) to develop a marketing plan to entice technology-based firms to the STP, particularly with respect to attracting research centers of large national and multinational companies, as well as to articulate research groups of the University to act in cooperative projects with these companies.

Conclusions

The research question posed was: ‘what makes STPs contribute to improving the quality of urban development?’

Albeit unique in each of the cases thoroughly studied and briefly reported in this article, the distinctive motivations to actively contribute to the quality of local urban development have in common the fact that they are present very early in the Park history. They are often linked to an opportunity, as in the narrative of Porto Digital, enabling access to a substantial grant, needed to make the STP take-off, conditioned to a complicated brownfield physical base. Similarly, in the case of Sapiens, the access to the huge area (4.3 million m²) that for years had been kept off-limits to economic activity was approved by the State assembly only after it was made clear that environmental concerns were perceived by the Park management not only as a restriction but also as driver to some of the projects to be installed.

It should not be understood that the access to essential resources (money, land, etc.) was the only motivation. On the contrary of becoming a bureaucratic burden, the deep involvement of STPs in the efforts to improve urban quality became a source of pride and distinctiveness. And, naturally, also a motto to attract tenants and partners. The uncertainties associated with such challenges and the need to carefully experiment models justifies the expression laboratories of innovation, used throughout this article.

Another means of contribution of the innovation habitats to the urban quest is the generation of appropriate new solutions by companies they nurture. An illustrative solution is Colab, an application aimed at connecting the citizens with the municipal authorities, using the potential of social networks. Launched in April 2013 by a start-up located in Porto Digital, Colab already got two coveted prizes: (i) the AppMyCity, given to the best application of urban interest at the New Cities Summit, and (ii) in February 2015, at the World Summit Award Mobile, with the partnership of the United Nations as of the world's five best platforms for government and participation. The young entrepreneurs used Recife as a test bench and, after receiving the first prize, got interest from other municipalities in Brazil, one of the Florianópolis.

From the studies conducted in this research, focusing on Brazilian cases, STPs may be important articulators for local/regional innovation systems. However, in order to optimize the articulation actions, it is essential to have access to tools and public policies that assist in the planning and coordination process, which can be organized on a local/regional basis, including metropolitan regions.

As can be seen in the Brazilian cases, as well as in those indicated in the literature review, STPs can be important inductors of qualification in degraded and depressed areas

in large urban centers. However, there are difficulties in deployment and development of these innovation habitats due to the need to overcome land property issues, particularly with regard to public properties.

Based on three of the cases studied, namely in the cities of Rio de Janeiro, Recife, and Florianopolis, the importance of coordination between the various levels of government, especially municipal and regional, is critical. A similar articulation has not yet occurred in the São Paulo case, which has delayed the implementation of the project. This has prevented the advance of qualified urban development in the region, which could take advantage of the opportunities derived from University of São Paulo's campus vicinity.

Some key lessons from urban technology parks projects, focusing on the Brazilian cases, are proposed:

- a) It is important to insert in the strategic planning of highly dense urban centers the new requirements of the knowledge economy. This takes advantage of the opportunity to develop innovation habitats' projects, such as STPs in degraded and depressed areas of the cities, with universities and research centers available as important anchors in the process of attracting businesses and investments.
- b) There should be mechanisms to attract investors for the development of real estate projects, especially considering the third generation of STPs and their 'live-work-play' features. As most Brazilian Parks arise from initiatives of the public sector, as an inducer of local/regional sustainable development, such projects are mostly based on public land. This makes it difficult to commercialize spaces for companies, as it requires public bidding, which tends to be cumbersome and lengthy.
- c) A major concern for the success of the urban STP projects is the infrastructure of the region where they operate, particularly with regard to energy supply, sanitation, communication, urban mobility, and strategic equipment. This might not be so clear at the early stages of such projects, as they tend to be initially restricted to specific areas. Nevertheless, it is of fundamental importance for the future vision for the STP's expansion, under the constraints of both urban space development (master plan, local strategies for social, economic and environmental development, etc.), and business opportunities.

Innovation habitats, such as the estimated 1,000 STPs that emerged since the 1950s worldwide, are eminent Triple Helix *loci*. They provide, in a concrete place, favorable conditions that are relevant for sustaining industry-academia-government dynamics towards systematic innovation.

Place in a STP is a tenet that goes beyond the physical reality of collocated academic laboratories, technology-based small companies, corporate R&D centers, and offices of public support agencies. Equally important is the *institutional space* established at the STP management apex, e.g., the Management Board, the Steering Committee and/or the Advisory Board. They are usually composed of top members of government, private sector, and *academia* who, in many cases, had no previous communication channels among them. The board meetings serve as mind openers, providing insights about the

values, rationale, priorities, and limitations of the other members. They also enable a collegial relationship, which facilitates the identification and negotiation of cooperation opportunities among the participating institutions.

The participation of a high-level representative of the STP city's mayor (sometimes the mayor himself/herself) is a strong inductor of innovative solutions for urban and regional transformation. Therefore, going beyond labels such as smart cities, knowledge cities, and others, the interaction between the City Hall and STP helps cities to be not only platforms but also objects of innovation.

The *mental space* occupied by these endeavors in the imagination of the local society is also of relevance. They become flagships of an alternative path that, on the one hand, leapfrog the traditional economic development process and, on the other hand, show the feasibility of embedding hi-tech innovation in the urban fabric.

Endnotes

^a*Brazil at a Glance*, available at <http://data.worldbank.org/country/brazil>.

^bAcronym, coined by an executive of an international large investment firm, of a group of large and intensely populated emerging economies: Brazil, Russia, India, China, and South Africa. This group created in 2014 a US\$ 40 billion capital jointly managed Development Bank, apart from the World Bank.

^cThe *City Prosperity Index* takes into account five components: productivity, quality of life, infrastructure, environment, and equity. Available at <http://mirror.unhabitat.org/pmss/listItemDetails.aspx?publicationID=3387>.

^dA science park is an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions. To enable these goals to be met, a Science Park stimulates and manages the flow of knowledge and technology among universities, R&D institutions, companies and markets; it facilitates the creation and growth of innovation-based companies through incubation and spin-off processes; and provides other value-added services together with high quality space and facilities' (IASP 2014).

^eANPROTEC - Brazilian Association of Science Parks and Business Incubators has approximately 280 members, including business incubators, STPs, education and research institutions, government bodies, and other entities focused on entrepreneurship and innovation.

^f'Social organization' is a public-private partnership model created by law in the mid-1990s, allowing private non-for-profit organizations to manage public assets and use them to provide services to society deemed relevant. The relation between the parties is regulated by a multi-year management contract that establishes clear and measurable objectives for the private organization and defines the funds that government will transfer to cover most of the costs involved. Received initially by the now ruling Workers' Party, then in the opposition, as a tool to destroy public service, the institutional innovation nevertheless flourished in the areas of health, culture, and science/technology.

Additional file

Additional file 1: Translation of the abstract into Arabic.

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