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Communities Shaping The Future of Science and Technology Parks: Usercentered Approaches As The Cornerstone for Technology and Industry Development – The Case of China

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New communities and social innovation: living and working environments

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COMMUNITIES SHAPING THE FUTURE OF SCIENCE AND TECHNOLOGY PARKS: USERCENTERED APPROACHES AS THE CORNERSTONE FOR TECHNOLOGY AND INDUSTRY DEVELOPMENT – THE CASE OF CHINA

This paper develops a conceptual approach for promoting synergies among technology, industry and community, assuming the latter as the cornerstone for such synergic interactions and for defining the organizational model of structures related to the innovation ecosystem. The paper provides concrete examples of this conceptual approach through selected living labs in China.

The paper critically assesses the traditional definition of Science and Technology Parks (STP), based on their organizational and functional attributes (generating knowledge flow, providing added value services, foster interactions among universities and companies, driving business growth and promoting territorial competitiveness, among others). It highlights end user demands and needs as the basis (cornerstone) for deploying technology and industry planning, development and growth and as the fundamental frame to structure the support organizations and infrastructures related to the innovation ecosystem.

The paper presents the results of inverting this traditional definition of STP, identifying and linking recent and relevant trends and concepts to this conceptual basis. It explores the increasing importance and impact of user-centered research methods (in which individuals as active subjects of the innovation process), such as contextual design, participatory design, and ambient intelligence, among others.
In this context of user-centered approaches, technology development is considered as a participatory decision making process, based on open innovation and supported by a multistakeholder platform in which the knowledge generation power is shared among Science, Technology and Innovation (STI) actors and the community as a whole.

Also within this context, industry growth is understood as a smart specialization initiative, as it considers the strengths, assets and endogenous potential of a specific community, embedded in a territory, as the driver for focusing and selecting investment in Research, Development and Innovation (RDI).

User-centered approaches also imply possibly substantial shifts in the organizational model of STP, moving from the traditional “triple helix” towards a PPPP (public-private-people partnership) to further strengthen the user-driven innovation process and its linkages to the community in which it is embedded. This PPPP can be framed as a living lab, which highlights the importance of RDI-dedicated structures in providing urban and territorial development solutions and in fostering smarter cities.

In order to exemplify how these conceptual trends and shifts are working in practice, three Chinese living labs have been selected: (i) Green China Lab – based on the Internet of Things and focused on developing smarter IT-related outputs for the benefit of the environment, energy and well-being; (ii) Mobile Life Club of China – based on co-design processes and multidisciplinary approaches applied to mobile technology; (iii) City Management Application Innovation Park – focused on reinventing city administration by the application of technology and of “innovation 2.0”. Together (although with different perspectives), these Chinese living labs face a common challenge of driving Chinese cities towards smarter and more sustainable territorial development standards.

ARTICLE

The concept of Science and Technology Park (STP) has been evolving since the very foundation of its first prototype - the Stanford Science Park - created in the Stanford University Campus (California, United States of America), in 1951. STPs were originally conceived as high-tech poles deemed at promoting scientific innovation and technological transfer between Universities and other research facilities and companies.
Due to the success Stanford Science Park had in upholding the transformation of Silicon Valley from one of the poorest regions in the United States into an international centre of science, technology, innovation and research, the STPs rapidly became a popular policy tool aimed at promoting regional development, firms' innovation and the creation of business and research synergies. However, such "universalization" contributed to a growing "conceptual dyslexia" of the STP definition. Consequently, it is important to analyse which are the most commonly accepted official definitions and, more specifically, to examine how these traditional definitions have been influenced, inverted and revisited by recent trends and underlying concepts.
Traditionally, the International Association of Science Parks' (IASP) STP definition is the most widely accepted. It basically states that:

"A Science Park is an organisation 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 amongst 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 International Board, 6 February 2002).

This STP caste definition is shared by the United Kingdom Science Park Association (UKSPA), which defined STPs as "a cluster of knowledge-based businesses (…) associated with a centre of technology such as a university or research institute" whose objective is to inspire the creation and development of knowledge-based business. (UKSPA, 1996). Accordingly, also UNESCO conceptualization lines with both IASP's and UKSPA's definitions, by stating that a STP is "an economic and technological development complex that aims to develop and foster the application of high technology to industry, (…) formally linked a centre of technological excellence, usually a university".

Relying upon the above analyzed definitions, it becomes crystal clear that the traditional STP concept focuses almost exclusively on organizational and functional aspects of these hi-tech spaces. Even if they vary in the way they are implemented and managed, STPs are usually established as independent legal organizations by national and local governments, research institutes and universities, private corporations and development foundations or any grouping of those, while, in terms of its governance model, they can whether be public, public-private, private, not profit, academic-related, hybrid or other.

Such a broad conceptualization actually reflects STPs' inclusiveness regarding the range and variety of functions that they are capable of undertaking within a country or region. Among these are, for instance, the linkage with the educational or research institutions, the provision of infrastructure and support services for businesses, the accomplishment of a knowledge, technology and innovation transfer function and the execution of an economic development function. In other words, STPs were understood as the best possible structure to promote business growth by effectively linking talent, technology, capital, and professional know-how.

Therefore, among the most common STPs' specific objectives are:

- Enable the cooperation that produces higher returns on existing investments in R&D and large-scale research facilities;
- Enhance the creation of new technology based firms;
- Meet the special needs of high-tech industries for infrastructure and associated services;
- Help local industries in terms of technological interdependence;
- Achieve critical mass in terms of co-located research facilities and staff;
- Contribute to the creation of jobs.

However comprehensive, the traditional definition of STP is nowadays turning out to be "narrow" and "closed" (Hanson et al., 2005) since it perceives STPs as an infrastructure where the simple proximity to a university will allow firms to innovate and profit on that knowledge, disregarding the relevance of other very relevant interactions and dynamics. In fact, this longestablished concept encompasses a top-down approach to science and technology where knowledge creation institutions (Universities and Research Centres) are exclusive players - they are the only actors that matter in the scientific process, from the inputs to the outputs (other actors, such as firms, national/regional governments, end-users, etc., just benefit from the whole process).

This so called "enclave" or "science push perspective" (Almeida et al. 2008) is in consonance with the core linear conception of innovation, under which a STP would be a platform where the knowledge and basic research outputs of Research Centres and Universities would be appropriated by firms that will implement applied and experimental research and, ultimately, innovate (Quintas et al., 1992). Westhead (1997) succeeded in synthesizing this classic perspective concluding that STPs were based on the postulation that innovation is a direct output of scientific research and these infrastructures are the perfect habitat to catalyze the transformation of pure research into innovation and production.

Such constricted STP definition started to raise issues regarding many procedural aspects of this locked model of organization, among which, according to Bellini et al. (2012), are:

- Doubts regarding the internal innovation services provided by the universities;
- Unclarity about the intermediary organizations and their roles;
- Loss of commercialization potential;
- Unwillingness to commercialize the research results;
- Disappointments regarding the intermediary organizations (e.g. high rents of technology parks, insufficient incubator services, lack of ability to attract venture capital into the region).

To the identified gaps, there is also a tenuous connection between STPs and the local environment, the inexistent participation of local actors in decision-making processes, the disregard of local potential, resources and needs in the scientific and technological process undertook by STPs, among others.

Nevertheless, time and recent trends have been contributing to an erosion of the classic definition of STP, given that it neglects the importance of articulating STPs with other infrastructures, actors and policies and firms. One of the sub-concepts that first came to question the traditional format scientific and technological format of theses spaces was the Regional Innovation System (RIS). The RIS perspective calls upon an integrated perspective of the innovation process, trying to somehow level the contribution of regional actors (STPs, government, firms, institutions, end-users, etc.) to the innovation process, through maximizing synergies and spillovers and emphasizing the need for deepened collaboration and networking to innovation. Current trends argue that STPs must leave the Research and Development (R&D) spectrum and follow an open paradigm, to be a focal point for research centres, universities, laboratories, firms, regional authorities, government agencies, financial institutions and even other business parks. Therefore, STPs should act as a stage where different organizations converge, interconnecting the various agents and thus enhancing interactions among them. The creation of a regional system of interrelated and connected technological infrastructures will boost regions' performance, minimizing the structural deficiencies these regions and address the needs of end-users.

There is another equally recent concept which has been proving to have a great influence in revising and revisiting the definition of STP, is the one of Open Innovation. The open innovation approach is an emerging paradigm that asserts that "useful knowledge is widely distributed", treating STPs' production of R&D as an open system which spreads out expertise through the outer world (Bellini et al., 2012). According to this perspective, STPs not only need to capitalize on region-specific characteristics, resources and assets, but also need favourable conditions (policies and incentives) that allow them to "move" between its walls and the world, the so called "local buzz" and the "global pipelines" (Bathelt et al., 2004). Indeed, if STPs are embedded in and pursue a regional policy it does not mean that they will solely rely upon the physical limits of the region itself, once that knowledge, innovation and R&D results cross over national and regional boundaries, as they do over sector boundaries as well (Asheim et al., 2011).

Considering this, Allen (2007) defines three generations of Science Parks:

- The first generation, dated from the 1980's, mostly focused on the infrastructure and the connection with higher education or research institutions;
- The second generation, dated from the 1990's, that considers the services to companies and the creation of networks related with the companies' needs;
- The third generation, already in the 21st century, where Parks are seen as collaborative and open spaces, that foster formal and informal "open" innovation, through actively promoting connections and links with entities located outside the park.

The natural evolution of STPs is, thus, towards a "smart park" where the mission of these spaces becomes to offer "premises and services for success into proactively creating and promoting an ecosystem of growth in its locations [where] the challenge is to make the entire community operate in a more growth-oriented, profitable and cost-efficient way" (Keith Silverang, in Bellini et al., 2012). Hence, departing from the classic definition of STP, the 2103 DG Regio Report "Setting UP, Managing and Evaluating EU Science and Technology Parks: An advice and guidance report on good practice", brings about a set of characteristics that 21st century STPs might have, already including some principles postulated by both the RIS and Open Innovation approaches.

Such features are:

- Operate careful tenant selection policies;
- Selectively prioritize the newer knowledge-based technology industries;
- Engage with the knowledge base (primarily universities and public research organizations);
- Engage cooperatively with other public and private sector actors;
- Own and/or operate one or more business incubation schemes;
- Provide professional business support and innovation services designed to increase the depth and extent of innovation-led and knowledge based business in their region or locality as well as within their park.

Contemporary approaches also intersect with the one of Triple Helix, a concept introduced by Etzkowitz and Leydesdorff in the 1990's, according to which the objective was to involve State, Academia and Industry in a creative interplay, by undertaking trilateral initiatives for knowledge-based economic development and agree on strategic alliances. Reflecting modern impetus of further STPs integration on the local environment, succeeding authors have added "market/society" as the fourth strand of the helix. The redefinition of this "Quadruple helix" is of the utmost importance, since the STPs outputs are ideally new and innovative products and services to the market and society.

Originally considered mere physical locations housing research activities, STPs are not an end itself but an important piece of the process of interaction, creativity and innovation, defined as a "gateway" to opportunity for its clients that are not a simple "destination" of the process. STPs' role is, thus, to work closely with other innovation actors, diligently building and operating networks and using their built environment to aid the processes of innovation. The contribution to the local development, considering the strengths, assets and endogenous potential of a given region and respective community, makes STPs a critical part of the smart specialization strategies, whose underlying idea is that STPs build on the whole socioeconomic context.
The most recent evolution of STPs is, however, greater than simply adjusting to a globalized scenario while focusing on local potential. Indeed, STPs are evolving towards a citizen-centred innovation setup based on knowledge economy, where the local community becomes an active agent in the socioeconomic of wealth generation within a given region – the so called Public-Private-People Partnership (PPPP). According to this approach, STPs are developing to become "Living Labs", a concept that was first introduced in the literature by William J. Mitchel aiming at studying people and their interaction with new technologies in a living environment.

Living Lab is a comprehensive concept which, on the one hand, can be defined as "citizendriven open innovation ecosystems in real-life settings in which innovation is fully integrated in the co-creative co-design processes for new technologies, products, services, and societal infrastructures" (Bertolin and Negre, 2012), or on the other hand, as "a user-centric milieu built on every-day practice and research, with an approach that facilitates user influence in open and distributed innovation processes engaging all relevant partners in real-life contexts, aiming to create sustainable values" (Bergvall-Kåreborn and Ståhlbröst, 2009).
This approach consents the appearance of new and renewed spaces for interaction and knowledge interchange that will bring to pass a significant change of paradigm in the collaboration between STPs and SMEs that will, for its part, lead towards an Open Innovation scenario.

Embedded in a broader smart specialization strategy, Living Labs highlight the importance of RDI-dedicated structures in providing urban and territorial development solutions and in fostering smarter locations. Living Labs are, then, a keystone that will enrich the capacity of a STP to act as an innovation engine for creating smart regions and will be the cornerstone of the competitiveness strengthening in the regions. In this open collaboration environment, innovation becomes something more than just the some of the parts, allowing new approaches, such as:

- Innovation forums (creating interaction and providing new insights among and between companies, public sector, and researchers);
- Innovation platforms (cooperation projects to gather local companies and Universities under the same innovation project);
- Living lab-environments promoting and testing user-driven technologies and ideas;
- Test beds to test new technologies in cooperation with companies and research organizations;
- Innovation partnerships (equal partnerships instead of subcontractor relation only);
- Open innovation projects and environments;
- Open source software;
- Innovation communities;
- Communities of practice.

As a methodology, Living Labs are grounded on the contribution of external ideas – researchers, every-day users and other stakeholders – as a means of innovation, typically driven to support innovation procedures for services and products. Particularly in Europe, the concept of Living Lab is being employed to "enhance innovation, inclusion and usability of ICT and its applications in the society" (Erikson et al, 2005) which fostered the development if the European Network of Living Labs (ENOLL), whose aim is to coordinate activities and share experiences at the European level.

Post-modern STPs in the production of science and knowledge, Living Labs are based upon five principles that make them unique structures in the innovation process. These five principles are, according to Bergvall-Kåreborn et al. (2009):

- Openess. It involves supporting open approaches between individuals, teams or companies, thus allowing to gather different perspectives and ideas from people with different backgrounds, knowledge and experience;
- Realism. It has to do with scenery where innovation action takes place, which ideally should be in a natural, realistic and real life venue;
- Influence. It has to do with the formulation if the 'users' as proactive contributors to the innovation process, and, correspondingly, with the critical role in the in the innovation processes that shape society;
- Sustainability. It concerns to the viability and responsibility of the Living Labs within the community they are inserted in;
- Value. It deals with the economic, business and consumer/user value of a Living Lab.

Among these fundamental principles, "influence" stands out as one of the cores of Living Labs. Indeed, at this level, the influence principle has to do with engaging users in such a way that it guides innovation in a desired direction, based on users' needs and desires. Living Labs efficiency has on the creative power of user communities one of its fundamentals, reason why it is important to stimulate and empower the users to engage in such processes.

Furthermore, the users' involvement in innovation processes can be regarded from diverse angles: it is expected to lead to more precise user requestes, concrete characteristics that meet users' requirements, enhanced user-friendly model of use and wider acceptance the produced knowledge.
This is strongly related to user-centric approaches of diverse types, such as "participatory design", and "co design".

Participatory design is set of theories, practices and methodologies whose core and common element is to include end-users as active participants in the technology design process. It has in its foundations the democratic ideal under which people who are affected by some event or decision should be given the