Asia-Pacific
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Science and Technology Parks: Catalysts in Promoting-Enabling Environments for Innovation

APEC Policy Partnership on Science, Technology and Innovation

January 2023

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APEC Project: PPSTI 02 2021A

Produced by
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APEC#223-PP-01.2

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Executive Summary

The present study analyzes various management models of science and technology parks (STP) and innovation areas, as well as different instruments, and success stories to extract learned lessons, best practices, and policy recommendations to support APEC economies in the implementation and management of STP.

The study also analyzes STP implemented strategies to overcome COVID-19 pandemic and the innovations on organizational models and business plan conducted in adaptation to the industry 4.0 paradigm changes.

The present study is based in a qualitative approach analyzing the result of an international workshops and a survey promoted by the National Council of Science, Technology and Innovation of Peru (CONCYTEC) with APEC support. This international event gathered the presentations and learned lessons from following study cases: Arizona University Tech Park (USA), TusPark (China), Thailand STP (Thailand), Tecnopuc (Brazil), Nuevo Leon STP (Mexico), Malaga Tech Park (Spain) and Litoral Santa Fe Tech Park (Argentine). The qualitative approach was complemented by a focus group analysis conformed by the STP CEOs and other experts from the APEC economies.

The target group was APEC government officials, private sector, stakeholders, and academia involved in the promotion and sustainable management of STP conforms the target group for the study.

The survey was constructed based on a complementary quantitative approach with questions about the three axes in a web-based form and was filled by 150 people including the speakers.

The experiences were grouped in three thematic axes: 1.) Implementation of STP: planning, strategy design and minimum standards; 2.) Management of STP aligned with sustainability, and digitalization, inclusion of SMEs and post-COVID-19 economic recovery, and 3.) Evolution of STP and their adaptation to the 4th Industrial Revolution.

The results present various organizational models and different instruments for STP development, success stories, learned lessons from the world class STP, recommendations and tools, while promote networking sharing international contacts to unite regional efforts in innovation processes for sustainable development at economical social and environmental level.

The result is discussed, and recommendations extracted to contribute to APEC economies in strengthening innovation ecosystems through the implementation, strategic management, and internationalization of STP. This study also aims to help in sharing and issuing best practices in the implementation and management of STP.as well as policy recommendations and a toolkit for strengthening and internationalizing STP to provide disruptive solutions to address COVID-19 pandemic and economic recovery.

Likewise, since STPs are long-term projects, the learned lessons analyzed could be an opportunity for APEC economies to prioritize and tuning capacity building programs and specific interventions on strengthening international cooperation networks for connecting these ecosystems.

Introduction

The existing wealth gap between emerging and developed economies in the APEC region is one of the main challenges we face. In this context, innovation plays a key role since, through its extensive use, higher quality economic and social growth can be generated. Science and Technology Parks (STP) are organizations 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. Also, the expressions "technology park," "technopole, "research park" and "science park" are within this definition (IASP, 2022)[1]. Therefore, the strategic management of STP has the potential to create high quality economic and social growth, as it has a crucial impact on the development of human capital, strengthening economic and productive structures, as well as on improving sophistication and value added of regional value chains to boost trade and economic development. STP play a pivotal role as enablers of the entities they host, helping their convergence and transition activities toward knowledge-based economy trends. These activities stimulate the preparedness of economies to face challenges, such as those of the current COVID-19 pandemic.

The National Council for Science, Technology and Technological Innovation of Peru (CONCYTEC) presented a proposal within the APEC organization aiming to promote the dissemination of various models and different instruments and success stories of STP to extract learned lessons and best practices from study cases and expert's discussions. The final purpose was to present recommendations and tools, while setting up a network of international contacts within APEC economies in the process of strengthening innovation ecosystems through the implementation, strategic management, and internationalization of STP.

The three themes that guided the activities of this study were: i) Implementation of science and technology parks: planning, strategy design and minimum standards; ii) Management of science and technology parks aligned with sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery, and iii) Evolution of science and technology parks and their adaptation to the 4th Industrial Revolution.

On the APEC, objectives, antecedents and 2040 Vision

The Asia Pacific Economic Cooperation Forum (APEC) aims to promote economic growth, technical and economic cooperation, facilitation and liberalization of trade and investment in the Asia-Pacific region. APEC gather twenty-one economies: Australia; Brunei Darussalam; Canada; Chile; China; Hong Kong, China; Indonesia; Japan; Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; Philippines; Russia; Singapore; Chinese Taipei; Thailand; United States and Viet Nam.

APEC was set up in Canberra, Australia, in November 1989, to intensify the Asia Pacific community feeling and reduce the differences between the economies of the region through a path of sustainable growth. Unlike the World Trade Organization and other multilateral forums, it is not a treaty or binding agreement. Decisions within APEC are made by consensus and commitments are made voluntarily to promote free trade and investment, accelerating regional economic

[1] https://www.iasp.ws/our-industry/the-role-of-stps-and-areas-of-innovation

integration, fostering economic and technical cooperation, enhancing human security, and facilitating a favorable and sustainable business environment.

APEC's vision presented in 1994, in the Leaders' Declaration of Bogor, Indonesia, was to achieve liberalization and facilitation of trade and investment by 2010 for developed economies (United States; Japan; Canada; Australia and New Zealand) and to 2020 for the developing economies. Likewise, APEC works to create a safe environment for the efficient movement of goods, services, and people in the region. The three pillars of APEC, consistent with this vision, are: 1) trade and investment liberalization, 2) trade and investment facilitation, and 3) technical and economic cooperation.

APEC members stand for approximately 60% of world GDP and 50% of world trade. Their affiliated economies concentrate around 50% of the world's population.

In 2013 at the meeting in Bali (Indonesia), APEC leaders reaffirmed their commitment to the rules-based multilateral trading system and achieved the successful outcome of the Doha Round at the 9th Ministerial Conference of the World Trade Organization (WTO). This meeting supported a multi-year plan on development and investment in infrastructure, foreseeing the creation of a Public-Private Partnership Center in Indonesia and promoting connectivity between people, through cross-border cooperation. The goal was to have one million university students within APEC in 2020 and the first joint Ministerial Meeting on Women and SMEs is held.

In 2014 (Beijing, China) the economies committed to take a concrete step towards greater regional economic integration by endorsing a roadmap to make the vision of the Free Trade Area of Asia-Pacific (FTAAP) a reality. The first APEC Connectivity Plan was implemented to achieve goals of better physical, institutional and people-to-people links throughout the region by 2025. It looks to promote innovation policies to achieve higher value-added growth, sustainability, and resource development humans.

Between 2015 and 2020, uneven global growth and the presence of risks and uncertainties in the global economy were recognized, and leaders agreed to set up policy enablers for the integration of micro, small and medium-sized enterprises in regional and global markets. It looks to develop human capital; the modernization of micro, small and medium enterprises; and improve regional food systems. The forum adopted the Multiannual Action Plan for Food Security and Climate Change 2018-2020 to guarantee food security in the region and development. The contributions of the multilateral trading system in achieving this are also recognized and leaders commit to promoting inclusive growth through innovation, such as the use of digital technologies. It is recognized that technologies are changing the way companies and governments work, and an Action Agenda for the Digital Economy was proposed to establish clear commitments to face the digital future. Emphasis was also placed on the need to elevate the role of women in the economy (La Serena Road Map for Women) and on Inclusive Growth. At the environmental level, two important ocean-related roadmaps are being developed to address marine debris and combat illegal, unreported and unregulated fishing.

In 2020, economies seek to overcome the challenges of COVID-19 and appear from the crisis through coordinated action and cooperation. They are committed to protecting people's lives and recognize the importance of working together to ensure a continuous flow of trade and investment, as well as fair access to vaccines and other medical countermeasures. In recognition of the disproportionate impact of the pandemic on those with untapped economic potential, APEC announced the intention to pursue inclusive economic actions to achieve an open, vibrant, resilient, and peaceful Asia-Pacific community. With the pandemic over, and responding to the immediate challenge of climate change, the agenda looks to promote trade and economic growth, while supporting policy directions to support future generations.

In 2020, APEC announces the Putrajaya Vision 2040, committed to APEC's mission and its voluntary, non-binding, consensus-building principles. It seeks to pursue the following three economic engines:

a. Trade and Investment: To ensure that Asia-Pacific still is the most dynamic and interconnected regional economy in the world, we recognize the importance of, and will continue to work together to provide, a free, open, fair, non-discriminatory, transparent, and predictable environment. APEC reaffirmed the support for the agreed rules of the WTO to achieve a well-functioning multilateral trading system and promote stability and predictability of international trade flows.
b. Innovation and Digitization: To empower all our people and businesses to take part and grow in an interconnected global economy. ("Asia-Pacific Economic Cooperation - Aotearoa Plan of Action") APEC will foster an enabling environment that is, among other things, market-driven and underpinned by the digital economy and innovation. Actions will be driven to seek structural reforms and socio-economic policies to promote innovation and improve productivity and dynamism, strengthen digital infrastructure, and accelerate digital transformation.
c. Strong, balanced, secure, sustainable, and inclusive growth: To ensure that the Asia-Pacific region is resilient to shocks, crises, pandemics, and other emergencies, APEC will foster quality growth that delivers tangible benefits and greater health and well-being for all, including MSMEs, women and others with untapped economic potential. ("Strong, Balanced, Secure, Sustainable and Inclusive Growth") APEC will intensify inclusive human resource development, as well as economic and technical cooperation to better equip the people in their economies with the skills and knowledge for the future. There is a consensus in the need to promote economic policies, cooperation, and growth that support global efforts to comprehensively address all environmental challenges, including climate change, extreme weather, and natural disasters, for a sustainable planet.

Science-Technology Parks and innovation areas in APEC's 2040 vision: possible catalysts in promoting an environment conducive to innovation and inclusive development with environmental sustainability?

The scientific-technological and social paradigm shifts that had been taking place in the last decade were catalyzed by the COVID-19 pandemic, where industries 4.0, biotechnologies and ICTs played a leading role. The human resources played a key role to overcome the health crisis and were in the center of the technological transformations. The local and global policies focused more than ever in inclusion, the promotion of female leadership in the scientific field, and environmental sustainability. These actions were also prioritized and promoted by the leaders of the APEC economies, as said in the previous section. The acceleration of the socioeconomic transformation processes has driven innovations in products, processes, business, and organizational models. The pandemic put in evidence the need to develop regional innovation systems, networking locally and globally to go into open innovation processes, open science, and open access to scientific data. Policies based on scientific evidence were promoted worldly to overcome the pandemic impacts.

STP and innovation were local connectors with global innovation systems and played a significant role in value creation and adding knowledge to productive chains. Their interventions eased in many cases the development of actions or policies to create smart districts, or regions.

These ecosystems interact with technology centers, universities, companies, technology-based business incubators, government actors, technology providers and other agents under open innovation processes. Impact studies showed significant results in creating economic, social, and environmental value in the regions where distributed and succeed in improving local employment conditions and quality of life.

The first STP was promoted by Stanford University in the United States, becoming an important technology transfer environment from the academy. It helped the creation of important companies such as Hewlett-Packard, Cisco Systems, VMware, Yahoo!, Google, and Sun Microsystems, which subsequently became multidomestic. These success stories encouraged the development of STPs throughout North America, with the Research Triangle Park in North Carolina, STPs at Duke University, Ann Arbor, and innovative areas in Massachusetts, such as Boston and MIT, among others, standing out among the pioneers.

In Asia, STPs/AOIs appeared mostly in the 1990s, and began to gain strength as of 2000. It is worth highlighting the pioneering efforts of Japan, and some emblematic cases in Korea; Chinese Taipei; Singapore; Malaysia; and Thailand, as well as the powerful, widespread, and massive activity of China and, more recently, of India. In these economies gigantic parks were created which many of them early evolved into Innovation Areas, or in some cases like Daejeon Innopolis (Daejeon, Korea), Bangalore (India) and Zhongruans (China) into innovation districts or smart cities.

In Latin American economies, the first attempts to develop STP date back to the mid-1980s, in Brazil. The elapsed time since the installation of the first initiatives has led policy makers to evaluate in deep the results and effects of these infrastructures supported by domestic and regional public policies since the early 2000s.

The first STP performance studies are based on surveys (Angulo et al., 2014) and were aimed at comparing the performance of companies installed inside and outside the parks. The metrics used evaluated financial success (e.g., growth in sales or income), innovative performance (e.g., number of patents, copyrights and creation of new products) and performance in generating new technology-based companies (incubated companies, their survival rate and the employment generated by them). Other studies (Link and Link, 2003) measure performance based on profitability, contributions to the local and regional economy, and the ability to interact with universities. In Asian economies, Chan (2005) assessed STP-hosted business incubators, based on case studies of six technology start-ups in the Hong Kong Science Park. The analysis was based on surveys that considered the following criteria: the advantages of these environments to combine and share resources, the consulting services offered, the benefits of the public image of the STP and the advantages of networking. They also surveyed the effects of clustering, geographic proximity, and the cost and resource subsidy system for financial support.

The existing wealth gap between emerging and developed economies in the APEC region is one of the main challenges to be faced in the evaluation processes of performance and impact results of these organizations. Innovation is associated with S&T policies as well as the environmental conditions present in the domestic and regional innovation systems of the different economies.

STP are organizations managed by specialized professionals, whose main goal is to increase the wealth of their community by promoting a culture of innovation and the competitiveness of their associated companies and knowledge-based institutions. From this definition promoted by the International Association of Science-Technology Parks and Innovation Areas (IASP), it is clear that human ware and leadership are substantial drivers in the strategic management of these organizations, to deploy their potential to generate high-quality economic and social growth. The necessary investment, governance and socio-productive specificities of each economy or region also affect the effectiveness and efficiency for the creation of value in productive chains, internationalization, access to global markets and promoting trade and economic development.

Within the framework of APEC, CONCYTEC of Peru has promoted an analysis of the various models and different instruments and success stories of science and technology parks (STPs) in the APEC economies, analyzing lessons learned by global STPs and promoting discussion and analysis processes within the framework of a focus group made up of actors from all the economies involved.

OBJECTIVES

The main goal of the project is to analyze various management models of STP, as well as different instruments, and success stories to extract learned lessons, best practices and policy recommendations to support APEC economies in the implementation and management of STP and a toolkit for strengthening and internationalizing STP to provide disruptive solutions to address COVID-19 pandemic and economic recovery

Through a discussion process with experts some recommendations will be presented and tools according to the best practices shared in the presentations of world class STP. The discussion will also help in evaluating STP strategies to overcome COVID-19 pandemic and the innovations on organizational models and business plan conducted in adaptation to the industry 4.0 paradigm changes. The outcomes of the international workshops that sustain the earlier process support recommendations on strategic management an internalization and pretends to contribute to APEC economies in the process of strengthening innovation ecosystems. The present study also aims to find policy recommendations and present a toolkit for strengthening STP networking and to share disruptive solutions implemented by world class STP to address COVID-19 pandemic and economic recovery.

The specific goals of the study are resumed in the three axes of the workshop and deals with:

1. To extract results from study cases on the STP potential to create synergies between academy, industry, and government to add value at regional level. These factors are closely related with science and technology policies, regional development plans presented in different APEC economies.
2. Another important topic to study appears from the STP potential to create synergies between ecosystem actors in sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery.

3. The study also looks to collect, discuss, and share experiences between different APEC economies on the adaptation and actions adopted by the STP facing the challenges caused by the paradigm's changes of the 4th Industrial Revolution, and the COVID economy.

These earlier mentioned objectives are aligned with APEC 2021´s priorities: economic and trade policies to strengthen recovery and seeking innovation and a recovery enabled by digitization. The results will be useful inputs for APECs STP to foster the strengthening and internationalization of their services as well as to address COVID-19 pandemic and economic recovery.

The study is also aligned with APEC 2020´s priorities: Inclusive economic participation through Digital Economy and Technology and Driving Innovative Sustainability and follows the operational principles on "Policy on APEC´s Capacity Building through Economic and Technical Cooperation (2015)". It is also aligned with the APEC Internet and Digital Economy Roadmap and the Accord on Innovative Development, Economic Reform and Growth.

METHODOLOGICAL APPROACH

APEC government officials, private sector, stakeholders, and academia involved in the promotion and sustainable management of STP conforms the target group for the study. Another expected output is gathering learned lessons both from developed economies and less mature ones on the development of innovation systems, clusters, and processes to transfer to all APEC economies. This will ease the flow of technology and knowledge and promote the development of technology-based enterprises and human capital. In this way, to the extent that the STPs achieve their goal, sustainable growth and equitable development can be achieved in the Asia-Pacific region; and consequently, reduce economic disparities between APEC economies.

Likewise, since STPs are long-term projects, the learned lessons analyzed could be an opportunity for APEC economies to prioritize and tuning capacity building programs and specific interventions where they are most needed. It should also be noted that the good practices identified and disseminated, as well as the STP management toolkit, can be replicated in APEC member economies.

According with proposed strategy in the previous section, the methodology aims to improve the knowledge by sharing experiences and learned lessons in three thematic axes:

1. Implementation of science and technology parks: planning, strategy design and minimum standards.

2. Management of science and technology parks aligned with sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery.

3. Evolution of science and technology parks and their adaptation to the 4th Industrial Revolution.

The thematic axes were structured to highlight the STP experience from both economies, extract the lessons learned and to address the questions raised in the previous section. The methodology includes a qualitative approach by interviews with the CEOs of 7 STP based on a semi-structured guideline to homogenize the criteria (Annex 1). In a second stage the outcomes of these interviews were presented for discussion with a focus group conformed with renowned STP managers and directors from the economies of Asia and Latin America. These sessions were moderated by experienced facilitators to identify the main strong ideas developed in each of the workshop axes. The International Workshop was virtual and counted with broad participation.

The agenda, workshop structure and the names and experience of speakers and moderators in each axis are presented in Annex 1.

The actions to achieve the proposed objectives can be summarized as follows:

1. Preparation and validation of the work plan, in consultation with the Project Overseer (PO); Holding consultation meetings with experts to identify speakers, moderators, and success stories. Identifying the more representative STP of both the Asian and Latin-American APEC economies and another relevant STP from the Iberoamerican economy as study cases. Performing a qualitative analysis based on interviews with their CEOs.
2. Results discussion by a focus group to enrich the process and complement the shared learned lesson from the study cases. Developing a Virtual Conference and Workshop to conform a focus group to whom the CEOs present their results and considerations according to the natural differences within APEC economies. This discussion was based on the learned lessons from the presented study cases: Arizona University Tech Park (USA), TusPark (China), Thailand STP (Thailand), Tecnopuc (Brazil), Nuevo Leon STP (Mexico), Malaga Tech Park (Spain) and Litoral Santa Fe Tech Park (Argentine).
3. The coronavirus pandemic has influenced the global economy and environment. Major victims of the COVID-19 outbreak are Micro and Small Enterprises (MSEs), especially in developing economies, mainly because of limited use of digital technologies. A recent study suggests that MSE managers and other stakeholders rethink their business strategies, incorporating crisis scenarios and business continuity plans to sustain customers virtually to enhance sustainable development (Bai, M. Quayson and J. Sarkis, 2021).[2] In the present study a Survey between the Virtual Conference and Workshop participants is carried out in order to analyze if the results of the study is consistent with the situation of SME allocated in the STP ecosystems. The survey was constructed based on a complementary quantitative approach[3] with questions about the three axes in a web-based form. It was filled by 150 people including the speakers.

The guiding lines to interviews and discussion on axis 3 thematic were based on the definitions and concepts on STP and Areas of Innovation (innovation districts) of Van Dinten and Jansen (2019). Table 1 shows the differences between both types of ecosystems according to these authors.

[2] Bai C, Quayson M, Sarkis J. COVID-19 pandemic digitization lessons for sustainable development of micro-and small-enterprises. Sustain Prod Consum. 2021 Jul; 27:1989-2001. doi: 10.1016/j.spc.2021.04.035. Epub 2021 May 8. PMID: 34722843; PMCID: PMC8542351.

[3] https://docs.google.com/forms/d/1oepfAKP0rF3XscewTP4UV5ukUOPas4ew1enmfmgdqZM/edit

Table 1. Differences between science parks and innovation districts (van Dinteren, J and P. Jansen, 2019)[4]

CHARACTERISTIC	INNOVATION DISTRICT	SCIENCE PARK
GEOGRAPHY	Central	Away from central areas of economic activity, often at the edge of a city
REACHABILITY	Multi-modal	Car-oriented
FUNCTIONS	Mix, including living	Mono-functional
SERVICES	Great variety	Limited
CULTURAL EVENTS AND FACILITIES (EMPLOYEE RELATED)	Wide range	No events or incidental
BUSINESS RELATED EVENTS	On a regularly basis	On a regularly basis
URBAN DESIGN	No master plans (Existing) urban environment with the addition of new buildings	Master plan New buildings and landscaping
AREA	No specific borders	Clearly bounded area
OWNERSHIP	Complex: many owners	One owner or a limited number
MANAGEMENT FOCUS	Focus on economic networks and the community Coordination	Focus on economic networks and real estate Control
TARGET GROUPS	Mix	Often a limited number
CHARACTERISTICS OF COMPANIES	Small or medium scale, easy to mix with other functions	Small, medium, and large scale companies. Limited environmental risks accepted.

Focus group analysis: Annex 1 presents the CV of the keynote speakers and moderators in the different thematic axes. These experts were complemented in the discussion stage with other international specialists with experience in the subjects under analysis.

Axis 1: The elements to consider implementing STP, particularly planning, strategy design and minimum standards are analyzed through cases such as the experience of the Province of Santa Fe in Argentine and the STP of Arizona (USA). Their representatives, Eduardo Matozo and Carol Stewart, were joined by Ana Sobarzo (director of the department of innovation and entrepreneurship at the Cayetano Heredia University in Peru) and Carlos Cardenas (director of the regional institute of technology and innovation of the government of Piura, Peru).

[4] Paper for 36th IASP World Conference, Nantes 24 - 27 September 2019

Axis 2: The focus group involved in the discussion of the main ideas shared by the keynotes speakers Jorge Audy and Suwipa Wanasathop is complemented with the participation of Carolina Briones, Executive Director of the Technological Center for Innovation in Construction (CTEC) of Chile, Sanat Wongthawethong Deputy Director of the Thailand Science Park and of the National Science and Technology Development Agency of Thailand and Sergio Zapata, Deputy Consulate General of Peru in San Francisco, USA.

Axis 3: The focus group on the adaptation of STP to the new revolution of industries 4.0 was made up of the representatives of Parque de Nuevo León and Tus Park, Marta Leal and Herbert Chen. José Luis Alesana join them, from the Technical University of Munich, a doctoral student in bioinformatics with experience working in parks in Chinese Taipei, China and Singapore. In addition, Omar Florez, a machine learning specialist at Tweeter Cortex, participates, among other topics, he was a researcher at Intel Labs, applied Deep learning and Machine learning, with numerous awards and recognitions. Pattravadee Abadie Ploykitikun, director of the STP of Thailand, doctorate from the University of Portland (USA), with experience in mechanical engineering, high tech, and project manager in clusters in her region

RESULTS

As mentioned in the previous section, the workshop was structured in 3 axes that involve aspects of Policies and strategies for the design and development of STPs, the management measures of these infrastructures to overcome the impacts of the Sars Covid 19 pandemic and the evolution in organizational models or bussies plans to adapt to the paradigm shifts in industries 4.0. During the presentations, it was noticed that many of these issues were closely related in the analysis of the study cases, as well as in the focus group discussion process. For this reason, the results and discussed are analyzed and considered in an integrated manner.

The University of Arizona Technology Park showed results of many years of experience in developing and operating these organizations. The University is in the core of the ecosystem and was the key institution in promoting actions to improve the interaction with the productive sector.

Tus Parks presentation put in evidence many changes in the demand of services from the STP due to the paradigm changes originated by the 4th industrial revolution and catalyzed by the Covid19 pandemic. Demand for free space and simple services changed, also the services for financial support, networking, and marketing. Other changes respond to the location of STP and the use their facilities. The new tendencies show new preferences for remote working or diversifying services and expanding the areas of influence. The STP are evolving to innovation areas or innovation districts. It is remarkable that key monitoring is a need to understanding the new real needs of customers and it is a good starting point of all work in the STPs.

From their experience in the new global scenario the Government has the role to states guidelines and policy making for the 4th Industrial Revolution. The industry is the engine for taking advantage of the new competitive advantages and prioritize networking to improving connections local and globally. Finally, the academic sector is also visualized like an important source of the innovation, and to direct research activities to problem solving. The financial support is another key factor to be considered in the toolbox for the development of small and medium enterprises to help targeting more sophisticated markets and improve trade. At the top of this pyramid is the society, the natural receptor of all these actions designed to achieve better living conditions as the final goal. Because of that, cultural and educational actions must be promoted as well as capacity building in health services. All the previous mentioned factors conform a long-term cooperation model of mutual benefit with resource suppliers instead of one-time use.

According to TUS Park experience, STP need to concentrate at how to provide the up to date and value-added service to the tenants in 4th IR. In the new environment conditions, it is the services which make the difference, and because of that, should be considered as key factors for improving regional competitivity. This vision leads to assign the best people in new services to succeed under the new paradigm change.

In summary, from their point of view the core function of the STPs is to create a reginal ecosystem conducive to the generation of great ideas, knowledge exchange and the growth of high-tech SMEs. Therefore, the STPs can play its role in both developed and developing economies, and in the past, present, and future industrial revolution.

With adaptation of the 4IR, the development trend of the STPs includes: the physical boundaries of the STPs are becoming more and more fuzzy, the service content is becoming more and more professional, the service form is constantly updated and modernized following the development of science and technology, and the Governance/Management body is becoming more and more diversified. No matter how the service content and form of the STPs are updated and developed, paying attention to the needs of customers, integrating multiple resources, selecting appropriate locations and infrastructure, and providing services required by customers are important core factors for the success of the STPs.

From Tecnopuc experience in Brazil, their vision is to be a key factor in the ecosystem of innovation, and a vector of transformation for the University and the society. The consensus system vision 2030 is to be recognized as a global environment for innovative business generating sustainable solutions for the university, society, and organizations. The strategic intention is to create 1000 new business initiatives in a ten-year period. They are also moving to be part of an innovation area in the Porto Alegre City which has been stated in a recent alliance for innovation, called “Pacto Alegre”, signed by three universities, local government, and industry.

To achieve this goal Tecnopuc proposed a new innovative organizational model with seven nodes:

1. Orchestration; that’s responsible for the governance, conducting the network under an institutional and political perspective. This node includes the legal and communication offices.
2. Tecnopuc Startups: This node oversees developing on innovative ventures and startups.
3. Tecnopuc Crialab: Responsible for training projects and services involving methodologies of creativity, design, and innovation.
4. Project Management: Responsible for the management of new projects and the analysis of demands arising from financial operations associated.
5. Social impact: Responsible for the development of entrepreneurial actors, aiming to identify opportunities to develop a culture of social impact.
6. New Business and Negotiation: Responsible for prospecting and commercializing the portfolio of products and services offered by the ecosystem to society and to the University.
7. Infrastructure Management: Responsible for the management of ecosystem support services, including the monitoring of the university units and third parties contracted services.

The TECNOPUC node’s organizational structure and interrelations are presented in Figure 1. Their strategy put in the center the governance of the ecosystem which is responsible for knitting the network between all the sectors and aligning them with a unified vision and long-time mission.

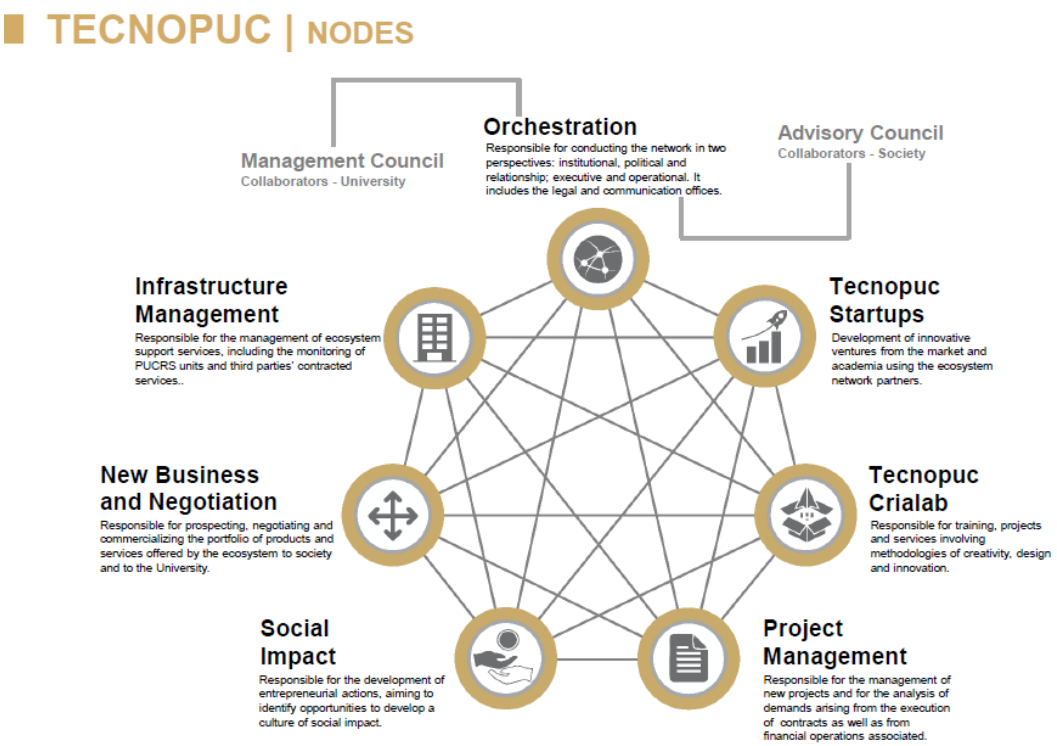


Figure 1. Tecnopuc organizational model, nodes, and relations (Source: Workshop Tecnopuc Presentation)

The Orchestration node has a Management Council, which provides inputs to Monitor strategic and operational management and acting in internal and external referrals and an Advisory Council. The last one is integrated by external collaborators and society actors and has the mission to advise on the guidelines and policies of TECNOPUC. Besides of that, it permanently evaluates the strategic positioning and their performance based on specific indicators. It also analyzes the annual activity report of the institution to extract learned lessons and recommendations.

The Startups development system is also another strategic node because of its supports in business creation and improving regional competitivity transforming the ventures ready for the market. As previously mentioned, the creation of new startups to improve the ecosystem dynamics is an important objective. The enterprise incubators are strategic organizations within the STP ecosystem.

The Nuevo Leon, Mexico case showed their strategic actions and results in transferring knowledge to the productive sector (Figure 2). Thera are many similarities in strategic goals with the results presented by Arizona Tech Park, Tus Park and Tecnopuc.

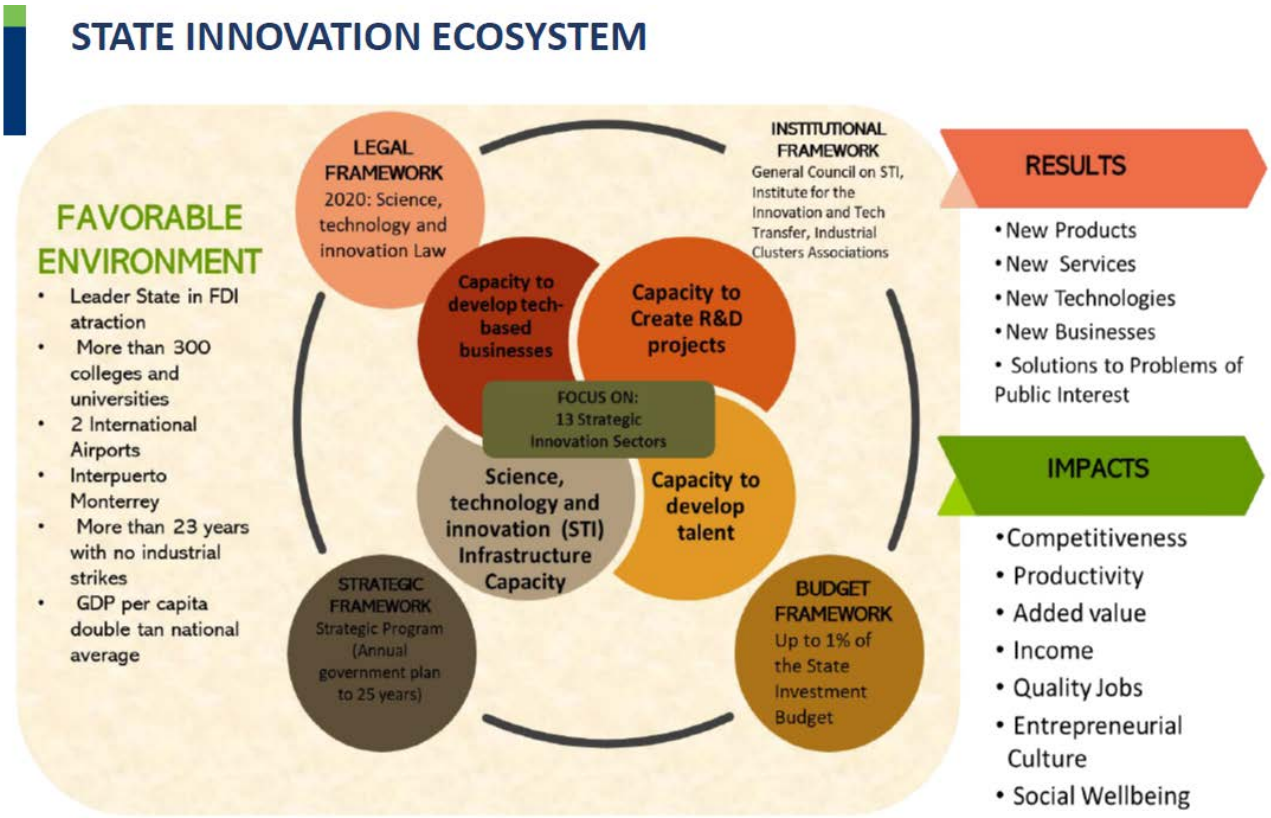


Figure 2. The innovation ecosystem in Nuevo Leon. Source: Workshop NL STP presentation.

The governance of Nuevo Leon STP has a triple helix-based management mode, promoted from PIIT Monterrey. This institution resulted from an emblematic governmental project with an important initial investment. The STP is operative since 2007 and in 2020 had received USD 112 million from State Government, USD 196 million from Federal Government and USD 364 million from private sector.

Universities, public research and development centers and companies interact within an open innovation model to create value in strategic sectors prioritized by the STP and the regional development system. The Figure 3 shows the ecosystem innovation model of PIIT Monterrey where capacities to talent development articulate with research infrastructures enhancing capacities to develop technological based companies.

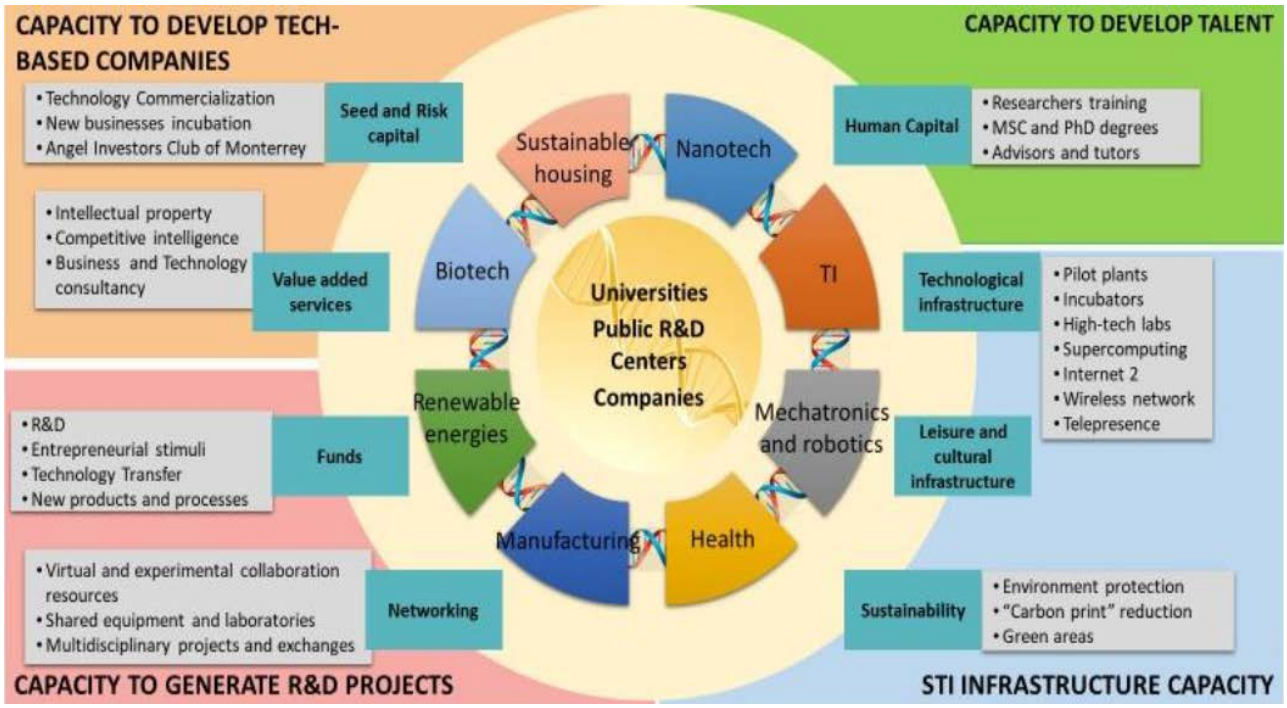


Figure 3. PIITs ecosystem innovation model supported by the local and federal government. Source: Workshop NL STP presentation

The human capital and the technological infrastructure are the key factors for improving the capacity of generating high quality research and development projects and new technological companies. These activities support local development and the connectivity with global ecosystems and with the society seeking directives to become an instrument of sustainability by environment protection, and carbon print reduction.

The main strategy promoted from Nuevo Leon innovation ecosystem is to evolve from a triple helix model to a Penta helix one that includes the society and investors capital. In this model, the 2027 vision is to convert Nuevo Leon in a Smart State with more high-tech enterprises, digital society, smart agrotech labs, smart health labs, remote health, and education centers.

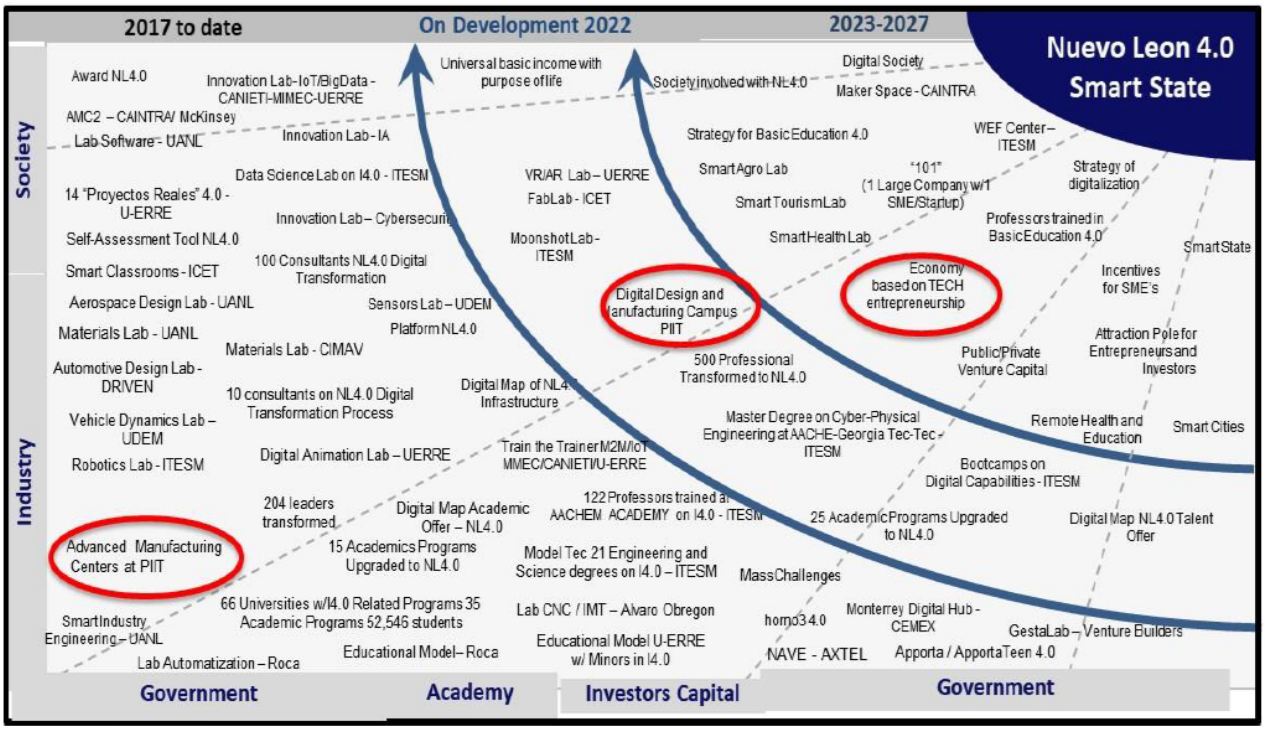


Figure 4. Nuevo Leon New Penta Helix development model. Source: Workshop NL presentation.

The figure 4 shows the main proposal of the Nuevo Leon 4.0 initiative that frame the strategic plan to achieve the goals described in the 2027 vision to become a Smart State.

Education	Technological infrastructure	Federal STI Ecosystem	Competitiveness and entrepreneurship	Government and society
• Basic and Vocational Education in STI and 4.0 industry	• Coverage and Access to digital connectivity	• Allocation of 1% of the GDP to humanities, ST and 4.0 innovation	• Public and private incentives for competitiveness and entrepreneurship in 4.0 industry	• Public policies to ease poverty and inequity with growth based on 4.0 industry
• Reconversion of the faculty to 4.0 industry	• Metropolis Decentralization through education, health and remote work with 4.0 technologies	• National Research System of the National Council for STI focused on 4.0 industry	• Support to SMEs for implementation and development of 4.0 technologies	• Eliminate bureaucracy, corruption and improve services for the citizenship with 4.0 technologies
• Reconversion of talent in companies to 4.0 industry	• Themed centers to develop 4.0 technologies rapidly	• Promotion of industrial property for 4.0 industry	• Programs to link companies' demand with local capacities	• Adequate social security policies with the help of 4.0 technologies
• Labs for 4.0 technology, products, processes and services development	• Makerspaces, fab-labs and tech-shops for 4.0 companies' incubation	• To consider the environment, and social and human development related with 4.0 industry	• Support to tech-based micro and SMEs	• Digital- connected Society and Government strategy
• Research at universities of the singularity and impact effect	• Support to companies for digital transformation	• Promotion of multi-helix collaboration and international alliances	• Access to rapid and economical risk capital	• Public policies to regulate the impact of 4.0 industry in the society

Figure 5. Nuevo Leon proposals to become a Smart State in the Industry 4.0 new paradigms. Source: Workshop NL presentation

The core components of this innovation environment deal with education, technological infrastructure, the whole federal STI system, competitiveness, and entrepreneurship and with Government and society.

The educational subsystem emphasizes in preparing new researchers, technicians, workers, or any society members to face the new industry 4.0 challenges. The technological infrastructure helps and assist the educational centers by making available for them makerspace, fab-labs, and tech shops for industries 4.0 startups or companies supporting them in digital transformation (Figure 5).

Axes 1. Implementation de STP.

The different environmental conditions for the development of STP in each economy are contemplated among all the discussed study cases. As an example, the STP of Santa Fe, Argentina, is 20 years old and although it was born in the 1990s, it only managed to consolidate in 2002. It is a public limited company with majority state participation with a triple helix steering structure in which the government, the academic (National University of the Litoral and CONICET) and business chambers interacts. The profile of this STP is biotechnological, and it is focused on human, environmental and agricultural health. They also have strategic lines directed to tics, nanotechnology, and scientific-technological services. Its specificity seeks to take advantage of the original knowledge creation capacities available in its region and of the main local production chains demands. In this STP the first and third exporting companies in the region are allocated and represent 41% of the exports of the city of Santa Fé. They also constitute an important source of specialized employment in the region having 500 jobs in house and high-quality employment (60% university degree and 10% completely postgraduate). The governmental support was fundamental to achieve these results and despite the STP receive a canon and occasionally subsidies depending on competitive funds, it is not enough to achieve economic independence. The object of governmental intervention is the promotion of regional development with environmental sustainability.

The STP in Arizona, incorporated since the inception stage the learned lessons from the Canadian experience on the campus of the University of Waterloo, where its CEO previously served. This STP has 3,000 knowledge workers and a world-class incubation center from which three unicorns were graduated with a turnover of more than USD 1 billion. The Arizona Tech Park has three components on 526 ha, with a couple hundred acres dedicated to solar power. It is a satellite of a previous STP started 12 years ago and now a days has 26 ha. The facilities are conformed by a main building and three additional projects in progress, and a business incubator for technology-based companies. The incubator supports eighty-three startups and is developing an expansion project, because of the importance assigned to entrepreneurship capacity creation and the impact in new businesses dynamics.

From the Latin American economies contrasts the presentation of less developed ecosystems where universities are often key players in the creation of STP but without sufficient governmental support for these projects. In the discussion session the case of a university park with an area of 102 ha, located in an urban environment was presented as an example. This STP despite of the university efforts in the creation stage still had important infrastructure limitations. It is worth noting that only this year they were able to have a water circuit and decent quality internet infrastructure. The university requested this territory from the government based in its vision of strengthening academy-industry articulation for productive development. Unfortunately, this initiative received no specific support and was directed to competitive funds. This situation is similar in most of the Latin American economies where the insufficiency or absence of specific support instruments for STI and industrial development policies is a problem to deal with. This situation is

even worst in private universities where the lack of public funding makes difficult to create STPs or innovation districts. Although in many cases the universities compete for funds and succeed in obtaining support this do not allow to cover infrastructure building.

The Piura region in Peru presents all the climates and opportunities to create a STP and because of the productive vocation of the area, both in agricultural and biotechnological products production represent a considerable proportion of domestic agro-industrial exports. These particularities are fully aligned with the vision presented from the Argentine experience. In this example the STP infrastructure was modular based on containers. The priority was put not just in infrastructure growth, but to focus on RIS3, and in promoting of regional development. Given the limitations in public financing, they would be seeking greater involvement of private capital at the domestic level and in the APEC economies.

In the discussion session, some appreciations were made on the fact that promoters from various sectors are required in STP creation, since the effort of a university, the regional government, or an isolated industry alone are enough. According to the experiences presented, the alignment of all the actors with a common vision is necessary to shape governance as well as a strong leadership.

Improving the relationship between the university and the government are necessary conditions, but not sufficient to ensure sustainable development. It is also required to involve the social actors of the region, and an institution with strong leadership to coordinate actions, and bringing the parties together. In the case of Litoral de Santa Fe STP, this role was fulfilled by the university, which had to work on legal engineering to enable other actors to become part of the ecosystem. When it is possible to show business success stories, it is easier to attract new companies and investments.

Another relevant factor in success cases, pointed out from the Canadian experience, is to have an Advisory Council, which interacts with the Board of Directors. The triple helix interaction must be present at multiple levels and not only in the management since it is not enough for a single institution to run the ecosystem functionality. When a leader leaves, there must be multiple levels to maintain the agreed vision in the consolidation process between actors. Otherwise, the rules of the game can be changed and investments, growth, or the viability of the project itself can be put at risk. One way to strengthen governance is to have the flexibility to incorporate new agents that could add value to the ecosystem.

Among the questions to answer on one hand arises the need to know how to define success, when this is a factor that drives and convinces the rest of the actors to join the project and in the other hand how possible is for the institution to be flexible and inclusive in extremely competitive environment. In this sense, it is understood that the concept of success is relative or at least there may be different considerations on how to measure it, but always must be associated with the fulfillment of the STP creation objectives and aligned with the consensus vision and mission. It is also planned to achieve success in stages, where initially the incubation of companies and the creation of startups should be promoted. In a second stage, when the system is more mature, it should be measured on how these companies have grown and evolved from the local to the global market according to the value achieved in their products and processes. It is a value chain, where each link must be worked on, identifying business opportunities, and adding value. Dissemination and communication strategies are key factors to reach political decision-maker interested in promoting these contexts.

From the experience of the Canadian STP of Waterloo, it is suggested that there was a moment when the leader set the challenge of reaching ten objectives for his community in 5 years and proposed evaluating the achievements, effectiveness, and systemic efficiency at the end of that period. Not only academic and technological challenges were included, but also environmental and social aspects to be addressed, collecting learned lessons from both successes and failures experiences. The role and capacities of the leader is the clue to conduct the ecosystem under a synergic approach in the triple helix and selecting the right and more empathic people constitute a great challenge that is not for those averse to risk. It takes a champion in the community to bring the rest of the players into line. The STPs are more than buildings, it is the people they have, the way they work with the region and how they interact with partners, the university and society. The role of community managers and the way in which they communicate and celebrate achievements begin to stand out.

In experts experience, the importance regional agendas of development under intelligent research and innovation strategies and productive differentiation (RIS3) allows the academic sector to perform mission-oriented research. It also helps in creation of alliances and partnering for supporting the defined strategy finding points of convergence and synergies between actors and institutions. Unfortunately, the empirical evidence shows that, in Latin American economies, unlike European ones, it is not common to have RIS3 policies or development agendas on which focusing research capabilities. A concern that also arises in these cases is how to prevent STP from being impacted by political changes brought about by democratic cycles and which often lead to a reset of the system with changes in objectives or priorities.

The Argentine STP, remarks from its experience the need to present to policy makers, since initial stages of the institutional development, the potential of the promoted changes or proposed solutions. In this sense, it is emphasized once again to have effective communication policies showing success stories from the beginning. Social appropriation helps to mitigate the instabilities of political changes because when the social perception of the achievements is good, as is the academic and business perception, it is difficult to stop the project. From Arizona University STP this vision is shared and emphasize in incorporating communication skills and activities into their culture, by celebrating all the achievements in the ecosystem (new investments, new business achievements, etc.). A strong leadership is required in the STP management to directing actions to consolidate long-term contractual relationships. These long-term contracts may generate a certain shield against the vulnerability of changes in political cycles, in addition to the wide dissemination and communication of achievements previously mentioned.

Many STPs that have been operating for a long time with no succeed in consolidating and achieving sustainability, because of not having the necessary financing support in the first years of operation. All focus group participants agree in the need of having a minimum infrastructure available in the founding process of the STPs otherwise it is difficult to attract investors and partners. This undoubtedly justifies governmental support moreover to overcome ecosystem important limitations on such critical issues like connectivity, security, and sanitation. In Latin America, private participation in infrastructures for the construction of an innovation ecosystem is not common, so the role of domestic and or regional governments is a key factor for developing STP capacities. These interventions could promote new dynamics and exchanges between sectors and facilitating the possibility of enterprise internationalization to reach higher quality. The complementary support of investment promotion agencies could help in achieving such positive results together with effective communication and marketing plans to attract other entrepreneurs. STPs are viewed as instruments of local development in the ecosystems where allocated. They generate dynamics

that helps in technological adaptation through hosted companies with the capacities and skilled people to do business with local production chains. The role of STP as instruments for local development in Latin-American economies explains that in many cases the low enrollment requirements for new enterprises regarding their innovative merit. In Asian economies, or in more mature ecosystems, priorities are put on attracting innovative companies, accessing to international markets, or at least with high export potential.

The STP industry is unique and collaborate with peer networks that's an important opportunity to take learned lessons from other ecosystems, to adapt strategies and seek to expand regional and global business. IASP, Incubator Associations, or other networks play an extremely significant role in this regard. In Waterloo STP worked with real estate companies to attract the right tenants to complement the university, raising capital through associations to achieve self-sustainability. Although it is advisable to see the lessons learned in other environments, it is necessary to develop a specific model for each economy because of its specificities.

During the discussion process, some questions were raised about what kind of networking to promote in the economies of developing economies. In this sense, it was concluded that previously is necessary to define the direct or indirect support instruments for the development of STP. In the Argentine STP experience, Litoral Santa Fe, they initially had the government support to count with minimal infrastructure. That was recognized as a key factor that obviously requires the existence of public policies focused on STP support and infrastructure creation. These policies should also strengthen the development of social capital, both through the promotion of entrepreneurship forums, the creation of a business accelerator with the support of investors from the stock market, etc. This social perception on STP as instrument for local development is crucial to obtain policy makers attention and support. Angel capital networks are also another way to engage with the community, and in more mature ecosystems, like Arizona STP that having 1.2 million people in their influence area have 350 angel networks. It took them 20 years to achieve the presented results in a very dynamic and competitive ecosystem that push them to reach the highest standards and levels of recognition to have community respect and support. The STP works with the Arizona Trade Authority and are always encouraging its participation in as many activities as possible. The local ecosystem is strong in mining and optics industries, so they got involved with those networks on tech missions. Among the successful cases that stand out are the soft-landing programs.

Even though Waterloo Park received forty-five million dollars as an initial investment in its founding process, they recognize it is difficult to achieve this support in less developed ecosystems considering that many of this investment has low visibility because is buried in sanitation, networks electrical grids, etc. The government role in supporting the founding companies of the ecosystem with a fiscal or tax subsidy was strategic and necessary to start this park. The government support despite in a more restricted dimension was also remarked as a key factor in province of Santa Fe, in Argentina ecosystem, which has 800 km of coastline on the Paraná River. In this case, a program launched by the Domestic Government to subsidize the preparation of the strategic and local development plan for STPs, and business incubators was well evaluated.

The governmental program to support a cluster coordinator or articulators was also mentioned as a key factor in many ecosystems helping to manage the local sustainability plan. Within the capital contributed by the partners in the formation of a STP, governmental subsidies are counted, such as those mentioned in the Argentine case, which included support for these organizations for two years, the teaching salaries of the academic partners as counterpart and the support from the

companies. This is shared by the most developed economies which had dedicated support from universities in backing the STP and a private sector entrepreneurship consortium where entrepreneurs donated their time as startup advisors or mentor, which in many cases later also supported. The community referred new startups to the incubator through industry leaders, and this strategy allowed reaching sustainability in the first year with less than 11 months of governmental support. These excellent results showed the need to build a community network, which provides security for STPs, incubators and the ecosystem. The more mature and developed the economies, the stronger the networks, the links and the quality of relations to promote added value.

As a final comment from the academic sector, it is understood that a STP cannot be installed out of nowhere in a place without the minimum environmental conditions for R&D&I. In the Latin American reality, STPs must be the consequence of a series of actions where entrepreneurship should first be promoted, then have an incubator that works and supports the development of intellectual property and transfer mechanisms, and then reach the innovation ecosystem infrastructure.

STPs and areas of innovation are a unique and special industry that requires that the actors involved have the experience of networking and incorporate lessons learned from other ecosystems since the founding process.

Axes 2. Management of science and technology parks aligned with sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery.

Despite the differences in the STP allocations presented in the study cases and the particularities in socio-productive environments conditions, the speakers remarked many coincidences from their experiences. Both TECNOPUC and the Thailand STP agreed in promoting changes to accelerate the digitalization of SME, the changes in organizational models and put the human ware in the center of the transformations and new strategies to overcome the covid 19 impact in the economy and in their regions.

From the perspective of TECNOPUC CEO, the STPs are perceived as builders of local ecosystems, so within a regional development strategy they have promoted business participation and the strong development of startups from the academic sector. In a complementary way, TECNOPUC has restructured their organizational model seeking to have a flatter pyramid, with few command levels, and working in flexible teams that are adaptable to changes in business or in the global economy. This vision in many aspects is complemented by the Thai experience which emphasized in the role of human resources as the protagonist of the change and adaptation processes. Additionally, both ecosystems are making a strong commitment to digitization, the need to promote virtual work and business environments among all agents. Open innovation, and internationalization platforms to connect local ecosystems with global ones were key factors in their strategic plans to support regional development.

In a complementary manner, the results of the survey conducted, which was answered by 150 participants, are presented. It shows that the strategies of adaptation to the paradigm changes of the 4.0 industries that are being adopted go through a diversification of the interest groups to whom the STP services are directed and achieved greater development in community management. Other measures considered were the reorientation of the role and position assigned to the scientific

component of the STPs, where it is proposed to support the creation of well-connected clusters with companies and local institutions.

Innovation Systems, such as Hubs, Parks, and Technological Incubators, consist in a coordinated set of agents that connect knowledge and innovation to production. In this regard, Rio Grande do Sul has created programs to promote each of these components of the system and play a prominent role in research, development, and innovation in Brazil and worldwide. Tecnopuc was a key agent in the construction of this ecosystem helping in transferring their learned lessons and experience.

The Program on Support to Technology Hubs has currently twenty-seven hubs. These consist of institutions that work together increasing the regional development and were established according to the criteria of the Regional Development Councils (Coredes). It was an effort that involves human resources, laboratories and equipment from universities, private companies or public bodies and associations, targeted to the creation of processes, products, or services. In each of the hubs there is at least one university responsible for the execution of the research projects consistent with the local productive vocations.

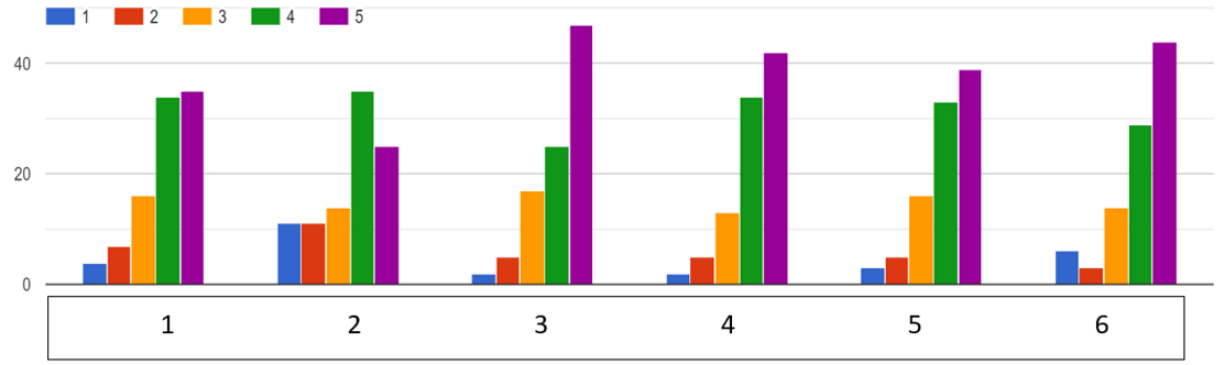
Technology-based incubators are responsible for integrating scientific research, technology transfer and development of new products. The Rio Grande do Sul Incubators program supports this activity. New incubators can apply for the program support at any time granted access for funding launched yearly.

As for the Rio Grande do Sul's Program of Technology Parks, it aims to contribute to the expansion of investments in scientific and technological research, technological development, and incorporation of innovative technologies, by increasing the competitiveness of the State's economy. These tools will stimulate the generation of business, work, and income. This network, currently formed by twelve parks registered at the program, induces the creation of local companies and the attraction of investments to Rio Grande do Sul.

The innovation system of Rio Grande do Sul in numbers:

- 27 technology hubs
- 12 registered technology parks, 14 technology parks associated to Rio Grande do Sul's Network of Parks and Incubators (Reginpe)
- 19 registered incubators
- At least two large startup accelerators: WOW and Ventiur
- 190 startups, in 30 cities, registered by Rio Grande do Sul's Startups Association

Results of the survey: Strategies adopted or in process to improve the competitiveness in STP in the paradigm shifts of the 4th Industrial Revolution (scale: 1 lesser, to 5 greater):



Strategies to maintain or improve competitiveness of STP in the paradigm shifts of the 4.0 Industrial Revolution	
1	Shift towards multiple target groups (diversification).
2	Lying more emphasis on community management.
3	Setting out new strategies (re-orientation of the position and role of science parks in their urban and regional context).
4	Creation of specialized clusters well connected with companies and institutions in the innovative region.
5	Innovation in organizational model
6	Innovation in business models

The survey also confirmed for the STP the findings and the COVID 19 pandemic digitization lessons for sustainable enterprises presented in Table 2.

Table 2. COVID-19 pandemic digitization lessons for sustainable development of micro-and small- enterprises (Source: adapted from Bai, M. Quayson and J. Sarkis, 2021).[5]

Business Dimension	*Digital transformation application*	*Impact on sustainability/resilience of MSE*
Process and system	*Automation tools to replace labor*	*Production can continue during a lockdown, and social distancing*
	Using Point of Sale (POS)	*Reduce the cost of production to increase profit*
	Demand for digital learning platforms	*Increase employee skill to be more productive*
	Demand for energy-efficient technology	*Reduce energy use and enhances environmental sustainability*
	Information system of Business to Business (BandB)	*Enhances customer experience that increases sales and profit*
	Recycling technology	*Reduce environmental pollution caused by waste*
	Using tools for customer data analysis	*Predict customer preference and sales to increase profit*

[5] Bai C, Quayson M, Sarkis J. COVID-19 pandemic digitization lessons for sustainable development of micro-and small-enterprises. Sustain Prod Consum. 2021 Jul; 27:1989-2001. doi: 10.1016/j.spc.2021.04.035. Epub 2021 May 8. PMID: 34722843; PMCID: PMC8542351.

	Green IT	*Smart use of IT that lowers the environmental impact of manufacturing, operations, etc.*
	Inventory management system	*Avoid excess stocked inventory and potential shortage, thereby increasing profit*
	Integrate e-commerce, mobile multimedia, and manufacturer app into one system	*The use of digital marketing tools enhances customer experience to increases sales and profit*

Customers	*Social media account and social media advertising*	*Customer virtual engagement to drive sales even partial lockdown*
	ONLINE AUCTION	*INCREASE SALES AND VIRTUAL CUSTOMER EXPERIENCE*
	LIVE BROADCAST	*VIRTUAL ENGAGEMENT WITH CUSTOMERS TO INCREASE SALES AND CUSTOMER EXPERIENCE*
	CHAT ROBOT	*REDUCE HUMAN TO HUMAN CONTACT THAT DRIVES SALES DURING RESTRICTIONS*
	DEMAND ENVIRONMENTALLY FRIENDLY PRODUCTION TECHNOLOGIES	*REDUCE ENVIRONMENTAL POLLUTION*
	E-COMMERCE FOR SALES CHANNEL	*INCREASES SALES AND PROFIT*
	HAVE A WEBSITE FOR SELLING	*INCREASES SALES AND PROFIT EVEN IN CONTACT RESTRICTIONS*
	Platform to resell and donate items	*Reduces waste and environmental pollution*
PRODUCTS	*Free Wi-Fi*	*A better customer experience that increases profit*

Another important result found in the discussions is the consensus of the significant role played by business incubators within STPs. In this sense, both the Latin American experiences and those of the economies of Asia, North America and Europe showed their inclusion as protagonists in the processes of internal and regional change. The new startups are more knowledge-intensive and many of them have made important contributions by providing products and services of great relevance to face the global health crisis generated by COVID 19.

Axes 3.

Monitoring Customer Demands in 4IR

Demand changes by different Industrial Revolution
Free space + simple service
Simple service + Financial support
Financial support + Networking + Marketing ….

Demand changes by location:
Central area: may needs only the financial support
Remote area: may needs networking + information + training…

Demand changes by the size of the tenants
Big Company: needs only basic service
Small company: may needs training and consulting support.

The Key: Monitoring / Understanding the real needs of customers is the starting point of all work in the STPs

Integrate necessary resources in 4IR

- **Government:** Guide line and policy maker for 4IR…
- **Industry:** help each other, Chain construction/ connnections…
- **Academy:** Source of the Innovation…
- **Research Institute:** Source of research result / Problem solve…
- **Financial:** Power plant for the SME development…
- **Intermediate: Market, T**rade, Media, accountant, lawyer … …
- **Good living condition:** School, Hotel, Hospital, Mall, Opera house…

The key: Form a long-term cooperation model of mutual benefit with resource suppliers instead of one-time use.

Some considerations made from the Asian economy are in line with the previous exposed results and emphasize in that the core function of the STPs is to create a reginal ecosystem conducive to the generation of great ideas, knowledge exchange and the growth of high-tech SMEs. Therefore, the STPs play this role in both developed and developing economies, and in the past, present and future industrial revolution. With adaptation of the 4IR, the development trend of the STPs includes: the physical boundaries of the STPs are becoming more and more fuzzy, the service content is becoming more and more professional, the services are constantly updated and modernized following the development of science and technology, and the Governance/Management body is becoming more and more diversified. No matter how the service content and ways the STPs are updated and developed, paying attention to the needs of customers, integrating multiple resources, selecting appropriate locations and infrastructure, and providing services required by customers all are important core factors for the success.

STP are not closed entities, so they need to set out new strategies and a re-orient of their position and role in the urban and regional context. There is an emerging tendency in STP in making efforts to expand their boundaries in the territory promoting the creation of Areas of Innovation. These zones have its own specific management team, and their main objectives include economic development through the promotion and attraction of selective innovative business for which specific services are provided. It may also include residential and cultural areas or facilities, embedded in urban spaces with which the economic aspects of the area of innovation interact (Sanz, 2016)[6].

During the workshop, an attempt was made to identify points of interest within the APEC economies to strengthen intra-regional ties, promoting win-win relationships. As mentioned previously for all parks, business incubation processes are a key component within their ecosystems. Networking between regions allows these companies to create opportunities to reach global markets. It is proposed as an opportunity for APEC economies to create synergies between business co-incubation projects. International networks such as the IASP have specialization and broad experience in connecting different ecosystems having presence in Asia, America, and Africa.

From the Asian communities' significant efforts have been made to make available and internationalize their research infrastructures. There is an economic corridor project in East Asia seen as an opportunity to attract investment, create startups or soft landings for them. During the discussion sessions a study case in the construction sector of Chile was presented to be considered as an example. Chile has vast experience in anti-seismic housing engineering and architecture and is moving towards technologies and industries 4.0. Its construction innovation STP focuses on companies and aims to accompany them in incorporating more environmentally friendly, sustainable technologies to contribute in decarbonization and energy efficiency. In this case, a local hub that interconnects the local offer with greater demands such as those generated from the Asian economy was presented putting in evidence the added value for local development. On the other hand, the ecosystem also has demands for developments conducted in Thailand and China (demotics, IOT, ICTs, etc.) to feed back their innovation processes. These are transforming their local ecosystem to be more innovative and keep in mind the concept of open innovation where their STP would be a key interconnection agent.

The pandemic accelerated digital transformation processes in the industry and within the management, governance, and sustainability models of innovation ecosystems. There is a need to develop hybrid platforms where virtual work is jointly promoted, to support the creation of global startups that can play a particularly key role worldwide. The social component must always be present by seeking integration, improvement in the quality of life and ensuring that no one is left behind in the transformation and adaptation to paradigm changes processes. Human talent, and the ability to create agreed visions and leadership in all sectors will inspire to achieve the scope of desirable future scenarios according to prospective studies conducted in all economies.

Business models based on virtual and hybrid structures make it possible to shorten the distances between regions and speed up the incorporation of value in the different ecosystems, taking the lessons learned globally and adapting them to the specificities of each economy.

[6] *Sanz, L. (2016). Understanding areas of innovation. In A. Nilina, J. Pique & L. Sanz (Eds.), Areas of innovation in a global world (e-book). IASP.*

APEC is an instrument to interconnect the supply and demand networks between different regional economies, each with its own specialization and competitive advantages. One of the challenges and goals to be addressed in the short term within APEC economies is the development of open innovation processes between different regions and sectors. The leadership and experience of STP could be an important asset to help in targeting this goal though global networking, competitive intelligence, and enterprise clustering in sectors like food industry, construction, engineering or other value chains. This was raised in many Asian STP with strategic actions and efforts in creating new services to connect startups from all economies with big business. In Thailand, direct foreign investment is encouraged in areas intensive in knowledge and innovation, this economy seeks to be a hub in Asia and aims to promote links with Japan; Korea and China economies. Also, from China where having achieved the internalization of their STP, are planning to go on in new expanding processes promoting links and new business with Europe and America. Networking is a strategic component in most STPs, but it is also in universities, outside of them, between regions and between companies.

The importance of the government support is highlighted in all the economies and mentioned as a key action for the development of innovation ecosystems. The more mature the economy is, the more diverse and differentiated public support instruments availability to target organizations at any development stage. These public interventions in supporting and promoting the STP also responds to the attributed significant role and potential of this organizations in the achievement of the Sustainable Development Goals defined by the United Nations (SDG 2030). That is mean the need of promoting social and environmental sustainability in addition to the economic and market focus. The tools for achieving these goals are not generic because of regional different capacities and opportunities. In many cases prioritized actions could be focused on renewable energies, and others in circular economy but in any case, a top-down vision is needed to be shared by all the actors in territory.

Intellectual property should be another central aspect in open innovation processes. STPs also can be important platforms assisting in strategies to protect inventions, intelligence surveillance and another related services for entrepreneurs in the regional ecosystem. The STPs could allow to accelerate development through contributions in the creation of intelligence networks between the APEC economies to help all the actors. When betting on disruptive technologies, the role of knowledge protection instruments is more relevant in business creation. In less developed economies, although not having the same relevance these instruments could be used in technological adaptation, bringing licensed solutions to local problems solving in any fields.

Inventions and innovations are in many economies the cornerstones of successful competitive products and business reforms. The innovative ideas may come from the needs of markets from customers, or from university research among other actors but not all of them are ready to become marketable products. There is an ideation and development phase, in which several projects should be under way simultaneously, because all of them will not be successful. After several phases, many inventions can be converted into finished products that are taken into production and marketed. The development phase requires plenty of creative effort, know-how and financial resources, for which outside expertise is usually needed. First assistance in developing an idea into a product for business is often received from Innovation Centers and Start-up or spin-off companies begin their activities often in incubators, which often are in or are part of STP.

Cross-border open innovation increases competition and hence the pressure for excellence in research, development, and innovation. ("UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE Policy dispatch - UNECE") It holds the potential to accelerate innovative solutions to the problems facing modern economies and societies. It can make domestic innovation systems more efficient and can lead to increases in the return to investment in research and development. This in turn strengthens the incentives for such investments and leads to a higher R&D intensity and hence a higher knowledge intensity in the economy. In turn, this improves international competitiveness. Because open innovation involves different partners, and frequently partners from different economies, it brings its own challenges in the management of intellectual property.

In the "DNA" of the STP should be the development of knowledge, creativity, purpose, and intentionality to get out of the comfort zone and create a sustainable development from the social and environmental point of view. The accreditation of STPs and their certification under international quality standards is also perceived as a key factor to create intra- and inter-regional trust.

CONCLUSIONS

Technology parks and incubators vary in the way they are established and managed. They can be founded as independent legal organizations by state and local governments, universities and research institutes, development foundations, private corporations or any combination of those.

Depending on the institutional character of their founders, STP can be public or not-for-profit, private, academic-related, hybrid, and other.

Public or not-for-profit STP are sponsored by government and non-profit organizations and serve primarily the purpose of local economic development.

Private STP and incubators are run by investment groups or by real estate development partnerships. Their primary interests are economic reward for investment in tenant firms, new technology applications and other technological transfers, and added value through development of commercial and industrial real estate.

Academic-related STP and incubators are affiliated with universities and colleges and share some of the same objectives of public and private incubators. In addition, they are actively engaged in transferring research and development activities, spinning-off university research efforts, providing faculty with research opportunities, and alumni, faculty and associated groups with start-up business opportunities.

The so-called hybrid STP are joint efforts of government, non-profit agencies and/or private developers. These partnerships may offer access to government funding and resources, and private sector expertise and financing. While in developing economies like the US there is a diversity of park and incubator sponsorship, in the industrializing economies parks usually rely on a strong government support.

STPs create environments that foster collaboration, innovation, and entrepreneurship, and provide innovation services to support new technology-based firms in their activities. Many strategies for achieving these goals are based on promoting trade of new products and services developed in their ecosystems acting like local connectors with global ecosystems. The expertise needed in playing this role requires strong capabilities in intellectual property instruments, business models, and in the legal and normative framework at domestic and international level. The STP must have a look in international markets and commerce finding opportunities for the productive sector and the industries allocated in their territory.

The World Trade Organization report in 2021[7] finds that trade cooperation is instrumental in improving resilience to shocks, because it promotes greater diversification of products, suppliers, and markets. It points to ways in which trade can sustain economic resilience for households, firms, and governments, particularly when supported by complementary domestic policies and effective global cooperation. Diversifying supply sources and destination markets are two strategies for doing so, as is building inventory stocks of critical inputs. Many biotechnological enterprises allocated in STP, incubated within these ecosystems, or intricately linked to technological centers in their facilities helped to overcome the health crisis by adapting technologies and adopting some

[7] https://www.wto.org/english/res_e/booksp_e/wtr21_e/00_wtr21_e.pdf

of the mentioned strategies. During the COVID-19 crisis, despite some pandemic-related export restrictions, trade helped economies meet the skyrocketing demand for medical products and these technological based enterprises grew hiring scientist and technicians. In 2020, even as the value of global trade declined by 7.6 per cent, trade in medical supplies grew by 16 per cent. Trade in personal protective equipment Foreword by the WTO Director-General [5] increased by 50 per cent – and by 480 per cent for the textile face masks that have become so familiar to all of us. Trade in agricultural products remained stable in 2020, preventing the health crisis from becoming a food crisis. Once shocks begin to stabilize or dissipate, trade can accelerate economic recovery: on the import side, by facilitating access to competitively priced intermediate products and services; and on the export side, by enabling access to foreign demand. For poorer economies, the crisis put in evidence the need of developing their innovation ecosystems by the precariousness of long and complex global value chains with many economies struggling to acquire medical and other strategic supplies. The STP and innovation areas resulted useful instrument to promote these activities facilitating environment conditions to link enterprises with the academy in the search for adding more value in product and health services.

OCDE many responses for economic recovery from the COVID-19 crisis appointed to be durable and resilient, avoiding environmentally destructive investment patterns and activities. Unchecked, global environmental emergencies such as climate change and biodiversity loss could cause social and economic damages far larger than those caused by COVID-19. To avoid this, OCDE advice that economic recovery policies need to trigger investment and behavioral changes that will reduce the likelihood of future shocks and increase society's resilience to them when they do occur. Central to this approach is a focus on well-being and inclusiveness. Other key dimensions include alignment with long-term emission reduction goals, factoring in resilience to climate impacts, slowing biodiversity loss and increasing circularity of supply chains. STP are promoting in practice, recovery policies to cover several of these dimensions helping to achieve many of the UN-SDG 2030 in the regions where interact. During the workshops Tecnopuc and the Thailand Tech Park presented their interventions in the creation of clusters of enterprises specialized in many of these dimensions

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The term "Building Back Better" has been increasingly and widely used in the context of the economic recovery from COVID-19[8] and to manage this goal, OCDE states that recovery measures can be assessed across several key dimensions (Figure 6) that need urgent decisions taken today to incorporate a longer-term perspective. The STP are also challenged to "build back better" by incurring innovation in organizational models and services and listening new client's demands.

STP are going into virtualization processes improving their capabilities in networking, through hybrid platforms. They are adapting business models to take prove of recent technologies connecting local ecosystems to global ones. The COVID-19 pandemic just catalyzed changes that had been initiated in adaptation to industry 4.0 paradigm changes.

[8] https://www.wemeanbusinesscoalition.org/build-back-better/

Figure 6 OCDE dimensions for "Building Back Better" after COVID-19 recovery (Source: OCDE 2020)[9]

Most STPs host technological centers or universities in their ecosystems playing a critical role in technological transfer and in improving innovation processes. The concept of the quintuple helix refers with the interrelations between universities, industries, governments, societies and environments and it is sensitive to the role of entrepreneurial universities plays catalyzing the interactions among all the actors to add value in products and processes and to reach society.

STP are an industry with particularities depending on the regions where they interact. In the more developed economies, they are closer to the industrial sector, with investors and have easy access to higher value global markets. Likewise, in their initial stages they have been subsidized in their infrastructures either directly through the state or through the companies that have started these infrastructures that received tax refunds or important periods of fiscal subsidy. In these cases, like in the Arizona STP study case, have managed to achieve short-term sustainability, and have achieved particularly good interaction between the academic and industrial sectors.

In the economies of developing economies, in general, STPs have been promoted from the academic sector, presenting weaknesses in their link with the industrial sector and extraordinarily little support for specific public policies. In the success stories presented, the commitment to become important instruments for the development of their regions is seen as a common factor. This has meant that in their strategic plans they directed capacities to the formation or coordination of clusters of companies from the best represented sectors in the productive chains of their territories.

In both cases, they perceive the strengthening of networking as a necessity, both locally and globally. The establishment of links with other actors or regions allows the development of a more

[9] https://www.oecd.org/coronavirus/policy-responses/building-back-better-a-sustainable-resilient-recovery-after-covid-19-52b869f5/

attractive ecosystem to establish investments, develop new companies or businesses. The strategies presented pursued to convert STP in local hubs connecting with global innovation ecosystems. The international networks on STP helps and shortcuts in achieving this goal and joining these organizations could help newcomers in the industry since initial stages of their project development. The IASP present many instruments and opportunities to promote networking at all levels and has developed some specific instrument useful at planning stages, like its Strategigram and it also share benchmarking tools, surveys and publications gathering learned lessons in the industry worldwide.

Triple helix structures, with the participation of academia, government, and industry, are promoted in all these ecosystems. In all the presented study cases the need to promote this dynamic and virtual relations in all levels was emphasized, not just from the political-strategic subsystem, but also at management level, and in involving social actors. As previously exposed nowadays bibliography quintuple helix models are being considered but at least a fourth helix approach must be considered focusing on the society as the final receptor of the outcomes and impacts from these organizations. Society demands should be incorporated since the inception stage mobilizing local actors to create value not just in markets but also at social and environmental level.

Most of the study cases emphasized on the relevance of the participation of STP in cluster creations and in regional development plans. This is clearer in developed economies where there have been implemented RIS3 strategies and weaker in developing economies still conforming regional agendas.

The impacts of the pandemic have accelerated processes of change in business models and strategies that had been already unfolding because of the paradigm shifts brought about by industries 4.0. In this sense, ICTs, process automation and teleworking have led in many cases to rethink the real estate aspects of their businesses. In some cases, they have had to restructure the allocation of their surfaces (after the pandemic, information and communications technology companies have in many cases maintained decentralized work and less demanding office surfaces). In other cases, the STPs have diversified in terms of their specialty, becoming more generalists, incorporating companies from the ICT, biotechnology, cultural, environmental sectors, or even associated with primary production.

All the study cases put the human factor at the center of the change processes. The success of these organizations is often mentioned to be associated with leadership skills, that in most cases depends on the skills of their CEOs. Because of that, the discussion process raised the importance of establishing long-term contractual commitments as well as making efforts in the development of a common systemic vision among all the actors. Surveillance of these processes and periodic external evaluations are key actions to achieve the expected results together with maintain stakeholders and society well informed about actions, outcomes and impacts.

Another important coincidence in all presented cases was the significant role attributed to business incubators mentioned to be the core of these ecosystems. The awareness and creation of entrepreneurial capacities, the connection of startups with global ecosystems, facilitating the deployment of new companies in the territories, and the connection with venture capital and investors, are all factors promoted by them.

Technology business incubators provide a mechanism for technology transfer, promote the concept of growth through innovation and application of technology, support economic development strategies for small business development, and encourage growth from within local economies. They are focused only on companies based on innovative technologies; provide support, such as access to advanced technology laboratories, scientific equipment, and other technical and research resources, as well as to universities teaching staff and students. Their strong links to universities and research institutions, facilitate technology transfer and marketing.

The success of a technology incubator stems from a combination of the following factors: clear objectives, the incubator coordinator's profile, provision of services, shared resources, physical space, access to funding, and project selection. The STP plays often plays and significant role in developing incubators and in many cases provides administrative support and many graduated enterprises remain in their ecosystem.

In recent years, the adaptive processes are leading STPs to transcend the territories where they stay and become important partners of local governments where they stay, taking their experience to the creation of innovation areas or districts.

During the pandemic, STP in many Latin American economies, had a decrease in activity of around 80%, especially at the beginning of isolation or social distancing measures. Although gradually this has been reverting to situations of almost total return to face-to-face work, it has been seen that remains companies (especially digital ones or those that can conduct remote work without major inconveniences), that have not reoccupied their spaces. In many cases they have been negatively impacted by terminating location contracts or having partially reduced them, with the prospect that a mix between remote work and on-site work would remain. On the other hand, some lease contracts have been suspended or cancelled. This has created a new challenge: how to go from a scheme with a strong real estate component and the location of companies, research institutions and workers, to another with no physical presence based on services, networks, and virtuality. STP made special effort in this difficult scenario, to overcome the health crisis specifically through their startups involved with health services, biotechnology, or pharmaceuticals. These actors were very active in promoting or providing solutions that lead to the design and manufacture of new health equipment (masks, respirators), the creation of monitoring mechanisms for those infected or patients, and even conducting of epidemiological studies. Many efforts from technological centers allocated in these ecosystems were also directed at their own expenses in research on infections cures and in the forecasting of new ones. Other actions dealt with, the implementation of early warning systems, improve the efficiency and connection of old equipment, etc. This effort was based in the strong capabilities of the ecosystems in biotechnology, software, hardware, artificial intelligence, robotization, automation, among others.

There has also been changes in the relationship between STPs, governments, citizens, and cities. New purposes, new challenges and new mechanisms for their action have been found, which has made them more integrated, connected, attentive to the needs of the environment. Among them the following can be mentioned: a) Calls from local governments to develop certain devices for health or to develop latest information management systems; b) Calls to develop sanitation proposals; and c) Generation of linkage mechanism between innovators and entrepreneurs with already established and/or traditional companies.

The STP were challenged to innovate in organizational and business models, also in the creation of new services and help the ecosystem in adapting to industry 4.0 changes and post COVID 19

pandemic post recovery economy. In these processes they have transcended their boundaries becoming partners of local governments in developing areas of innovation. Th STP also are helping in regional development conforming clusters in different sectors and strategic areas defined in development plans.

The study cases also stressed in the many benefits of implementing open innovation and was mentioned in all the strategies presented including early participation in new technologies and job opportunities. Open innovation enables the simultaneous use of domestic and foreign research and development and projects that rely heavily on external development have shorter development times and require less investment than similar projects that rely entirely on R&D.

The new scenarios have pushed this organization to update and enhance computational skills to reach the society, policy makers and stakeholders. Accountability in all segments of the value chain, impact evaluation and external evaluation are key actions to achieve confidence and support to reach sustainability.

The strong links between STP and the universities or technological centers helping in knowledge development and mission-oriented research to solve many of the previously mentioned problems and challenges as well as taking prove on new opportunities from paradigm changes. Specifically, scientific knowledge, provided by the academic sector, is of great value in these first life cycle stages, when this basic knowledge has yet to be disseminated to the broader community and is not yet available. STP networks facilitate knowledge dissemination among similar firms, based on either formal agreements or informal interactions, requires proximity to be transmitted in the initial stages before this knowledge can be codified and patented.

RECOMMENDATIONS

Policy recommendations for APEC economies to strengthen and internationalize STPs to address the impact of the COVID-19 pandemic and thereby stimulate economic recovery.

The conclusions summarized above allow us to draw the following recommendations for policies in the APEC economies that allow the internationalization of STPs:

1. Promote networking by facilitating exchanges between STPs from different regions at the academic, business and government levels. Congresses or workshops like this one allow this type of connection. The post-pandemic will surely allow direct ties to be resumed through visits and exchanges between regions of the APEC economies, which it would be desirable to strengthen and develop on a regular basis.
2. Policies for communication and dissemination of success stories are key to attracting or mobilizing investors between the different regions. It would be advisable to strengthen communication instruments and actions on these issues within communication policies.
3. It would be advisable to promote actions so that the most developed parks of the Asian, North American, or European economies explore potential interactions with those of developing economies on issues where win-win actions may be identified according to the productive specificities of each party.

Toolkit for the strengthening and internationalization of science and technology parks.

Networking is a key factor in internationalization of STP and it is indeed facilitated by joining to international associations specialized in these topics. One good example is de International Association of STP and Innovation Areas (IASP)[10]. It is a worldwide membership-based association managed by experts in science and technology parks and areas of innovation, an independent, non-profit, non-governmental organization in Special Consultative Status with the Economic and Social Council of the United Nations.

The IASP coordinate an active network of managers of science/technology/research parks, innovation districts and other areas of innovation. It aims to enhance new business opportunities for members and their companies, increase the visibility of its members and multiply their global connections. The members of IASP participate at international forums organized by this institution and cooperate and assist the development of new parks and new areas of innovation.

It was created in 1984 and since then gather 350 members organizations with more than 115.000 companies allocated in their ecosystems. It is present in 78 economies with seven regional divisions (Europe, Africa, Asia Pacific, West Asia, Latin America, North America, and Eurasia).

Networking is at the heart of IASP, enabling their members to make meaningful connections through personal introductions, leading to new collaborations, new projects, and innovative ideas. IASP staff connect science park professionals with the right people at the right time, everywhere in

[10] https://www.iasp.ws/about-us/about-iasp

their network. Connects companies located at member science parks with potential clients for their technologies and innovations on a global basis.

IASP also organizes yearly world conferences that allow people meet, exchange knowledge and information, establish alliances and develop new joint projects.

Virtual networking through its platform is also an important source of knowledge and information. IASP facilitate the access to a comprehensive database of STP/AOI managers and forums to increase the interactions between all members.

IASP offers members access to two unique tools for analyzing their strategy and evaluating performance: the STP Performance Evaluator© and the Strategigram®.

STP Performance Evaluator©

The only one of its kind, this tool explores the added value an STP brings to its ecosystem, along with the economic impact it is generating or can expect to generate as it develops. The evaluator also uses an automated system to give both a quantitative and qualitative measure of performance alongside identifying areas for potential improvement. Where areas for potential improvement are identified, the tool recommends Inspiring Solutions from across the IASP community that can help.

The STP Performance Evaluator is made up of three reports: an Innovation Ecosystem Fit Report, an Added Value Report, and an Impact Report, with all offering different metrics on STP success. Uniquely, these reports offer aggregated values of output variables from STPs comparable to the user's park, allowing IASP members to understand their STP's strengths and areas for improvement in comparison to their peers.

Strategigram®

The IASP Strategigram is a unique software-based tool that enables STP managers to analyze their park's strategy, assess its evolution and compare it to other parks' strategic profiles.

The Strategigram is a service available for all IASP members and is being used with success as a tool to define the most suitable strategic model in the planning of new parks. Using seven strategic axes, it indicates the position of a STP on each axis based on specific and measurable indicators including governance models, location, target markets and degree of specialization. IASP can also conduct individual customized analysis on request.

Figure 7 shows an output of the IASP Strategigram Tool.

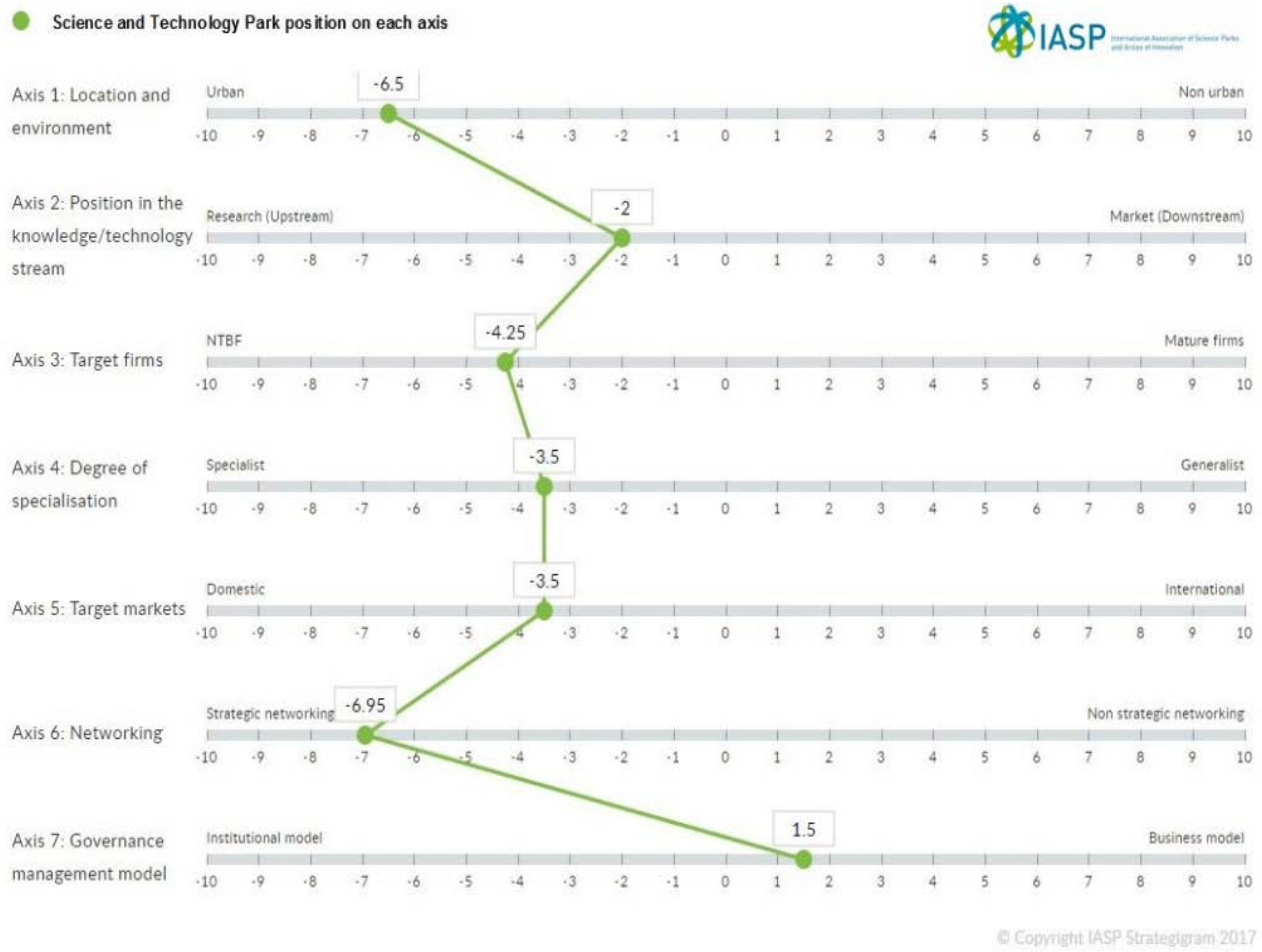


Figure 7. Example of output from IASP Strategigram tool. Source: IASP (2022)

Despite the STRATEGIGRAM is a good and useful tool the specificities presented by STP in each region make it difficult to generalize instruments or actions since each ecosystem has a different level of maturity and operates in different economies. The development of these organizations presents some difficulties and inconvenient when the minimum environmental conditions that justify them do not exist. In the past, some failures in the evaluation of these ex-conditions in some ante economies have led to investments in infrastructures that, subsequently, did not meet the expectations of the policies that promoted them and had a negative impact on the perception of these instruments. In other cases, the lack of articulation between agents or the discontinuity in the support due to changes in policy before reaching the equilibrium points were key factors that did not allow the objectives established in the founding process to be achieved.

Internationalization became a critical component of STP practices. In recent years, they have started to include, among the portfolio of their services, the support and fostering of their tenant firms' internationalization, such as soft-landing programs and international immersion experiences for start-ups.

The IASP Inspiring Solutions Programme is another important instrument that promotes networking. It is an award program to recognize excellence within science park and area of innovation management and give visibility to the best projects and initiatives. It also creates a library of best practices that other STPs/AOIs around the world can implement for themselves.

The solutions might be innovative ideas in any area of activity conducted by science parks and areas of innovation. They could be services provided to companies; latest ideas in business incubation, acceleration, or soft landing; innovative approaches to networking, internationalization, or

attracting talent; or initiatives to collaborate with the city and strengthen the whole innovation ecosystem. Every year 10 finalists are selected by an expert panel, before IASP members vote for the three winners, who are announced live at the IASP World Conference.

Soft-landing programs.

It is a set of services, practices and procedures that are developed when a company wants to internationalize its products or services.
There are "essential items" that are specific to the soft landing and others that can "collaborate" with said activity. Although there is no consensus to exactly define the limit between one and the other, below two lists are presented with some examples of service items:

1- Essential Items:

a) *Accountant – Financial advice*

b) *Legal / Notarial*

c) *Market research*

d) *Customs broker*

e) *Commercial representations – sales*

f) *International logistics*

***2*- Collaborative Items:**

a) *General Agency (Citizenship, Registration in public bodies, various procedures)*

b) *Real estate / Real estate*

c) *Insurance*

d) *Human Resources – personnel selection*

e) *Marketing, Process Reengineering, Planning, Design and Communication.*

f) *Coaching*

g) *Specific items or promotions of each economy (e.**g.,** maquila Paraguay)*

h) *Others*

The soft-landing programs offered by most STP give some important advantages to the ecosystem enterprises with internationalization plans:

1. Mitigation of economic risks
   Expansion plans require a significant initial investment and lack of international experience and the costs of accessing foreign markets are often deterrents. Therefore, by having reliable information and support from specialists within the target market, it is possible to know all aspects from the beginning, reducing the risks of economic expansion investment.

2. Faster business internationalization.
   Since establishing an expansion plan in a new market to starting it up, a long time can pass. This depends on the level of preparation of each company and the knowledge of the barriers to entry to the market, its experience in foreign trade, its aversion to risks and its commitment, among

others. The Soft-Landing service allows companies to quickly establish themselves with a legal, operational, and commercial structure. The STP that offer this service have local resources and give companies all the basic information and contacts necessary to conduct the investment process efficiently.

3. Benefit from expert insights into the economy, culture, and business practice in the first stage to have a successful landing the enterprise need to consider, not only the economic part, but also social information about the economy, its culture and the business practice used. These are determining points when interacting with the actors present in the new market since the way of doing business may change from one economy to another.

4. The STP local network and experience to introduce the enterprise to potential clients. The companies that receive the Soft-Landing services can also count on a network of appropriate contacts with people such as institutions, local companies, and a network of potential clients to achieve their goals in the new market. This advantage allows a better integration from the beginning and thus have the crucial support to start your activities with less risk.

International immersion experiences for start-ups.

Technology-based startup enterprises are an increasingly important part of the business landscape in Asia and the Pacific[11]. By applying innovative technologies to create new products and services, they can make a significant contribution to economic development while generating social and environmental benefits. However, to survive and then thrive, tech startups require an enabling ecosystem that includes supportive government policy, access to capital, skilled personnel, quality digital infrastructure and other elements.

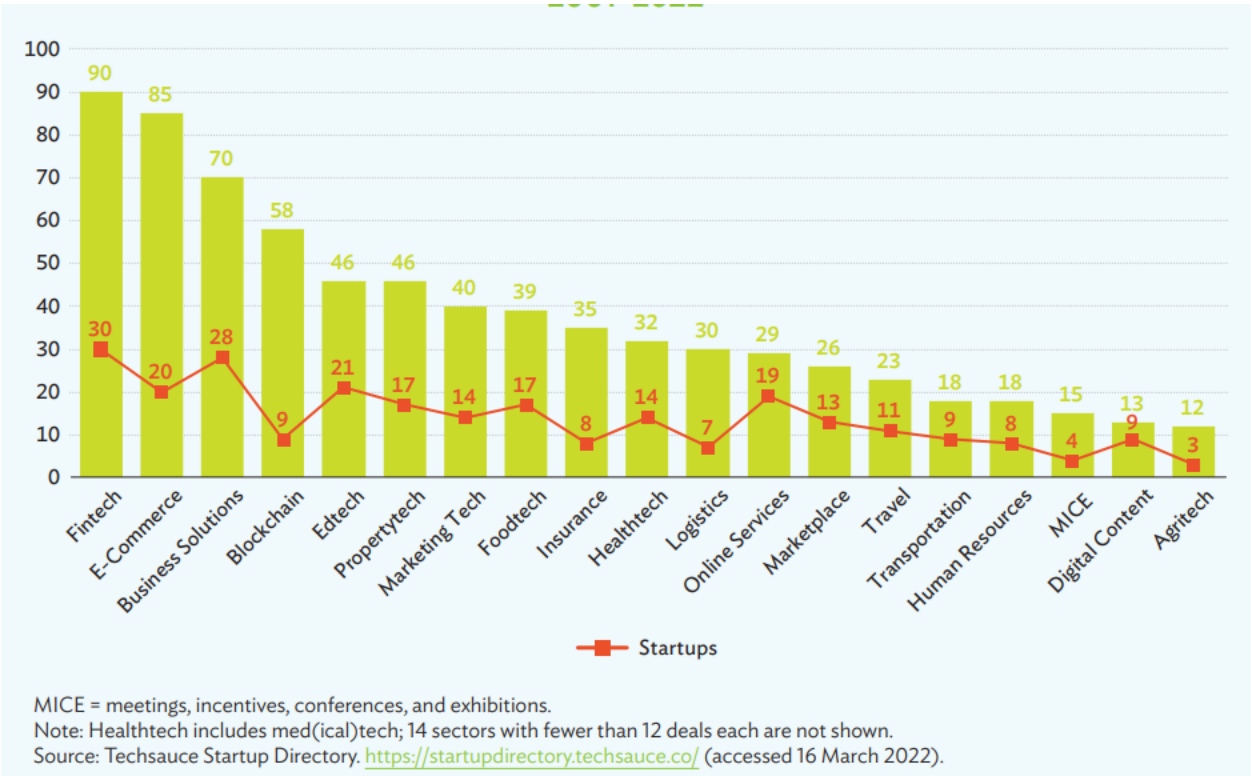
Startups operate in an ecosystem that includes financiers, digital infrastructure, government policies and programs, incubators and accelerators, and other organizations and players. In recent years, the Government of Thailand, has worked to create a supportive ecosystem. Since 2015, startups have become an additional growth engine for the Thai economy, attracting the attention of stakeholders including government, large corporations, academic institutions, and investors. Various activities and programs have been initiated to catalyze a vibrant ecosystem. However, more can be done to increase the number and variety of startups, especially in sectors beyond fintech and e-commerce, and to engage with more sophisticated technologies known as “deeptech.”

Startup Thailand 2016, a government-organized event, for raising awareness of tech startups and bringing the sector together. In 2016, the Thailand Ministry of Information and Communication Technology was reformed and renamed the Ministry of Digital Economy and Society (MDES). That same year, the National Startup Committee (NSC) was established to find ways to improve the ecosystem. The Software Industry Promotion Agency was also established and supported startups with coworking space and digital infrastructure. In 2017, the Digital Economy Promotion Agency was created under the MDES. The main sectors where startups are receiving incentives for international immersion are Fintech, E-Commerce, Business Solutions, Blockchain and Edtech (Figure 8).

Other relevant sectors are the Agritech that can help increase the productivity of farmers, who are among the poorest in society and Cleantech or Greentech which offers solutions to improve

[11] https://www.adb.org/publications/thailand-ecosystem-support-technology-startups

environmental sustainability and mitigate climate change. These sectors, along with inclusive fintech, are the focus of the Asian Development Bank's support for tech startups[12].



MICE = meetings, incentives, conferences, and exhibitions.
Note: Healthtech includes med(ical)tech; 14 sectors with fewer than 12 deals each are not shown.
Source: Techsauce Startup Directory. https://startupdirectory.techsauce.co/ (accessed 16 March 2022).

Figure 8. Number of startups by sector receiving investments in Thailand in 2091-2022

In 2017, the National Science Technology and Innovation Policy Office and the Thailand Tech Startup Association conducted an ecosystem survey[8]. The results showed that the top five sectors at the time were lifestyle; transportation, logistics, and fintech; marketing; travel and tourism; and e-commerce. About 58% of startup founders indicated that ecosystem support was inadequate. Additional support was needed for networking, client acquisition, knowledge sharing, and trade shows. In addition, 51% of founders sought a wider range of financing instruments, including equity, crowdfunding, and convertible bonds. Founders indicated that startups face three major obstacles: government regulation, a lack of human talent, and inadequate access to capital. The strengths of the ecosystem were the availability of mentors who were successful entrepreneurs and a strong payment system (Figure 9).

The study also found that one-third of startups use advanced digital technologies such as artificial intelligence, machine learning, virtual and artificial reality, big data, and the Internet of Things. Of 215 startups surveyed, 22% owned patents or had patents pending. For the startups without patents, the main reasons were that (i) they did not have patentable technology; (ii) it was not necessary for the business; and (iii) they considered it a complicated process to secure the patent. The survey also found that Thai startups have an average of three to four founders, with more male than female founders. The average age when a company is founded is 33 years old. The average number of employees when a startup is launched is four, increasing to six after 2 years. The survey also found a shortage in three types of talent: technology experts (developers, programmers, and data scientists), researchers, and marketers.

[12] https://www.adb.org/sites/default/files/publication/817496/thailand-ecosystem-support-technology-startups.pdf

Support Factors	Obstacle Factors
• Startup skills and opportunity perception • Acceptance and culture of entrepreneurship • Internal market dynamics • Physical infrastructure • Startup opportunity • Economic stability • Geographic location	• Limited ability to internationalize • Lack of technology absorption capability • Limited entrepreneurial education and deep technology • Limited technology talent and developers • No focus on high-growth startups • Lack of idea- and seed-stage funding • Risk capacity

Figure 9. Supports and Obstacles presented in Thailand's Entrepreneurial Ecosystem (Source: https://www.gemconsortium.org/)

The Thailand STP presented many instruments and strategic lines as a Platform for Open Innovation helping in soft-landing and connectivity between local and global ecosystems (Figure 10). The Science Park is also perceived as an Infrastructure for Knowledge Industry and as an International Innovation Platform. The main promoted lines are on knowledge sharing among tenants and visitors, industry visits focusing on food chain enterprises and auto parts industries, research and innovation match making (matching firms, tenants, and domestic centers of its ecosystem). Other strategic activities are directed to the innovation deal flow, facilitating matching large firms with startups and SME.

Figure 10. Strategic actions of Thailand STP as a platform for open innovation and startups soft-landing or connectivity with potential partners. Source: Workshop Thailand STP presentation.

Thailand STP started in 2002, conforms an innovation hub gathering The Northern STP that interact with six local universities, the Software Thailand Park, and the Southern STP. It has eighty acres that holds 110 companies, many of them operating internationally. The ecosystem also has five domestic research centers with modern research infrastructures where work more than three thousand well trained researchers, technicians, and support personnel. It allocates a Nanotec

center, a Biotech center, Co working space, Pilot plants a Convention Center among other facilities. A summary of the hub capacities is presented in Figure 11.

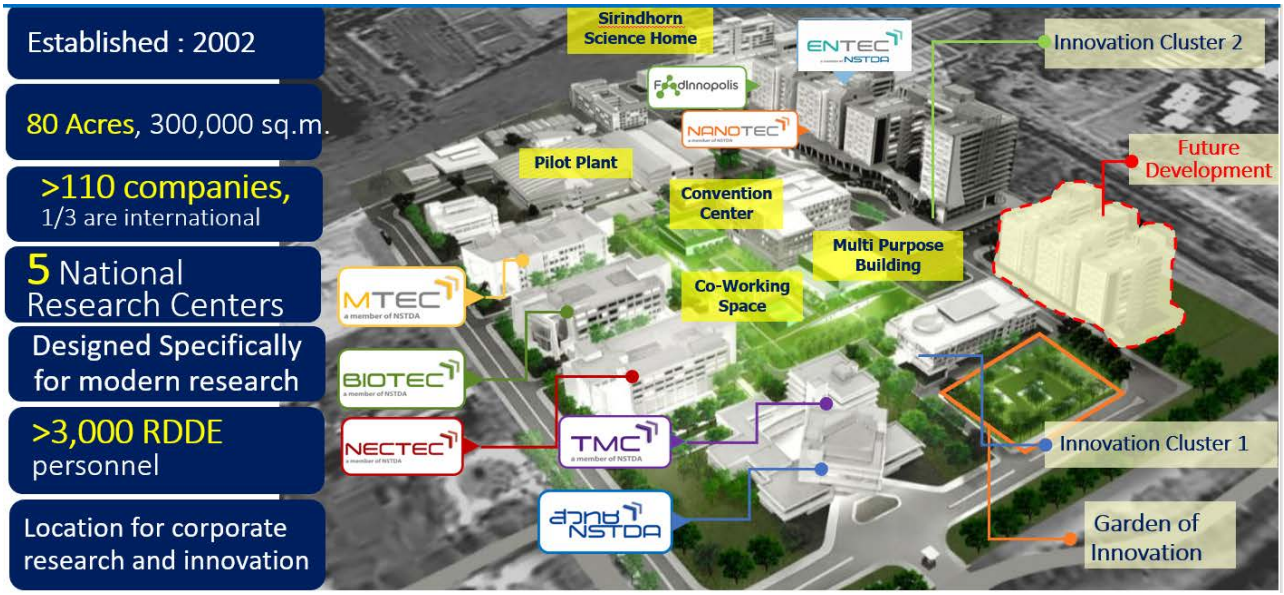


Figure 11. Summary of Thailand STP hub capacities and infrastructures. Source: Workshop Thailand STP Presentation.

This STP is also an international collaboration platform that have many programs with strategic partners in developed economies all over the world that helps in facilitating startups immersion experiences and new business opportunities. Figure 12 illustrates the international network of the Thailand STP hub.

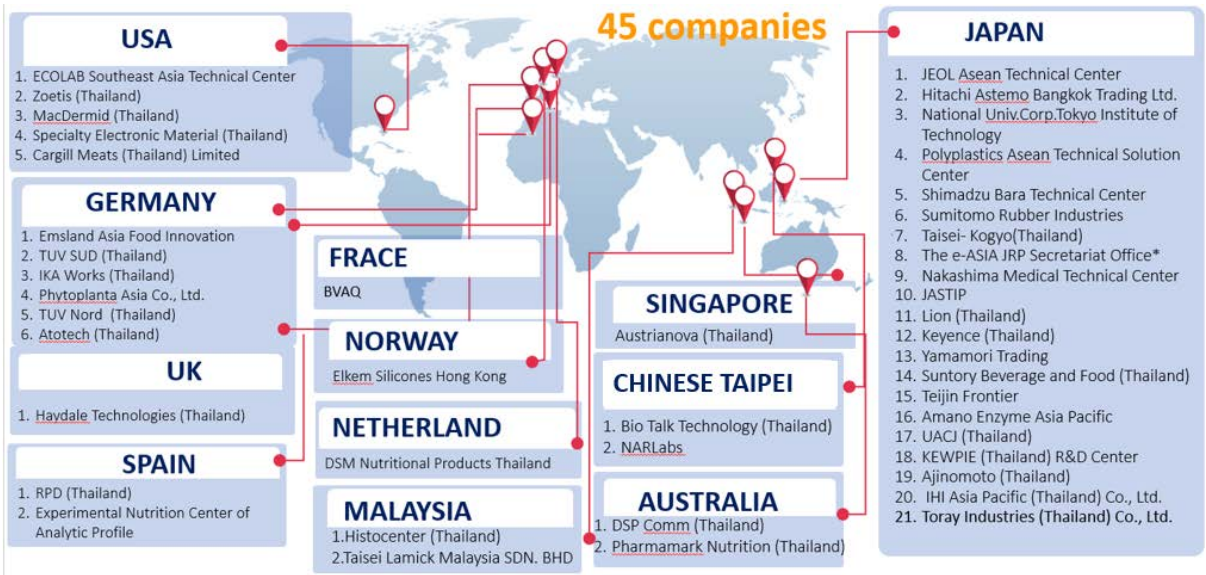


Figure 12. Thailand STP connections with international centers in different developed economies. Source: Workshop Thailand STP presentation.

Another import STP from the Asian economies is Tus-Holdings Co., Ltd. (hereinafter referred to as TUS), set up in July 2000. It is the former Tsinghua University Science Park (TusPark) Development Centre founded in August 1994 and conforms an S&T investment holdings group established in reliance on Tsinghua University focusing on S&T services.

TUS developed a model integrating incubation services, financial investment, entrepreneurship training, open innovation, and an end-to-end financial service platform. It invests in seven sectors including clean energy, new materials, digital information, environment protection, life sciences, education & training, and culture & sports. Unique Triple Helix Model — 'Science Park + Investment + Incubation' of TusPark has been helping enterprises grow their businesses. It has incubated over 10,000 enterprises, over 40 of which are successfully listed.

TusPark is one of the core platforms of TUS for the construction of the innovation and entrepreneurship service system. TusPark cluster has a science park network that covers major economies and regions around the world, which has made outstanding contributions to the promotion of regional industrial transformation & upgrading and enhancement of innovation capability.

In the past 20 years, TusPark provides integrated operation and management services for the governments and various science parks, including park planning, investment promotion, talent attraction, industrial service, technological investment, development, and construction.

After more than two decades of development and exploration, TUS has accumulated a wealth of experience in the planning, construction, and operation management of innovation network, established a high-caliber management team, and actively promoted the organic interaction between innovation resources and the regional economy. It has successfully built a global innovation service network with more than 300 incubators, science parks and tech towns as carriers, covering more than 80 cities and regions at home and abroad, such as Beijing; Shanghai; Shenzhen; Nanjing; Xian; Chinese Taipei; Hong Kong, China ; Macau; the USA; Canada; the UK; Italy; Russia; Thailand; Malaysia and more, making it China's biggest innovation ecosystem.

TusPark Cambridge is the latest addition to TUS Holdings' unique 'Science Park + Incubation + Investment' development model. With an investment of £200M from TusPark, the landmark joint venture with Trinity College at the University of Cambridge was established. TusPark Cambridge consists of 350,000 sq ft of office/lab space across five new buildings, including a state-of-the-art Bio-Innovation Centre – an environment that fuels creative and lateral thinking. From HQ style

buildings for established businesses to incubator space for smaller companies on the move, we can meet a range of requirements.

TusPark Newcastle works with Barclays Eagle Labs, the latest cluster of tech incubators in the UK, connecting UK companies directly to Chinese industries, universities, and governments across the TusPark global network.

Other important experience in constructing innovation ecosystems was presented by the University of Arizona STP, which is a hub that can link enterprises all over the world and connecting with investors, technological centers, or open innovation opportunities.

The figure 13 shows the subsidiary organizations promoted and where shows to be one of the more concerned protagonists.

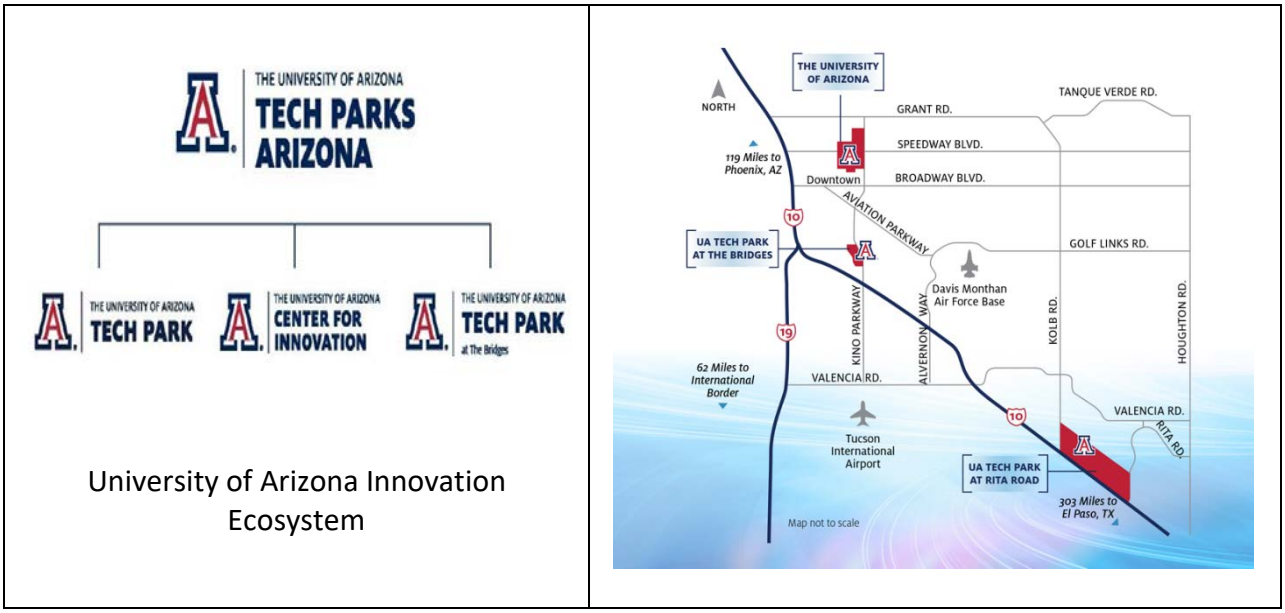


Figure 13. Subsidiary organizations of the Arizona Tech Park ecosystem. Source: University of Arizona STP Workshop presentation.

The University of Arizona innovation ecosystem is based on two Tech Parks and a Center for Innovation. The region where it is located has strong connections with logistic strategical facilities like the Tucson International Airport and to important highways. Tech Parks Arizona creates the place, environment, and interactive ground that generates, attracts, and retains technology companies and talent in alignment with the research, mission, and goals of the University of Arizona (UA). Tech Parks Arizona directs the UA Tech Park at Rita Road, UA Tech Park at The Bridges, and the University of Arizona (UA) Center for Innovation with the highest priority of recruiting companies with connections to the UA to locate at these facilities.

Tech Parks Arizona is deeply aligned with the research, mission and goals of the University of Arizona, a world-class Tier One research university. Companies can leverage the University of Arizona's knowledge and resources to supply innovative solutions to today's global challenges. The University of Arizona academic community is dreaming big and creating incredible innovations to make a better world.

The University of Arizona (UA) is a premier public research university. The University is recognized as a world leader in research and innovation with expertise in advanced energy, defense and security, bioscience, mining technology, arid lands agriculture and water, and intelligent transportation systems and smart vehicles.

UA was established in 1885 and receives more than $687 million annually in research funding. The National Science Foundation ranks it #22 among the economy's top public universities and colleges. As the state's land-grant institution, it has offices in every county and more than 500 community outreach programs statewide.

The University of Arizona Science and Technology Park (UA Tech Park) and The UA Tech Park - The Bridges, are owned by the Arizona Board of Regents (ABOR) on behalf of the University of Arizona (UA). The development, operation, marketing, and leasing of the parks are managed through the Campus Research Corporation (CRC). The University was assisted in the acquisition of the UA Tech Park by the Arizona Research Park Authority (ARPA).

The Figure 14 illustrates the institutionalism involved around these STP and the Center:

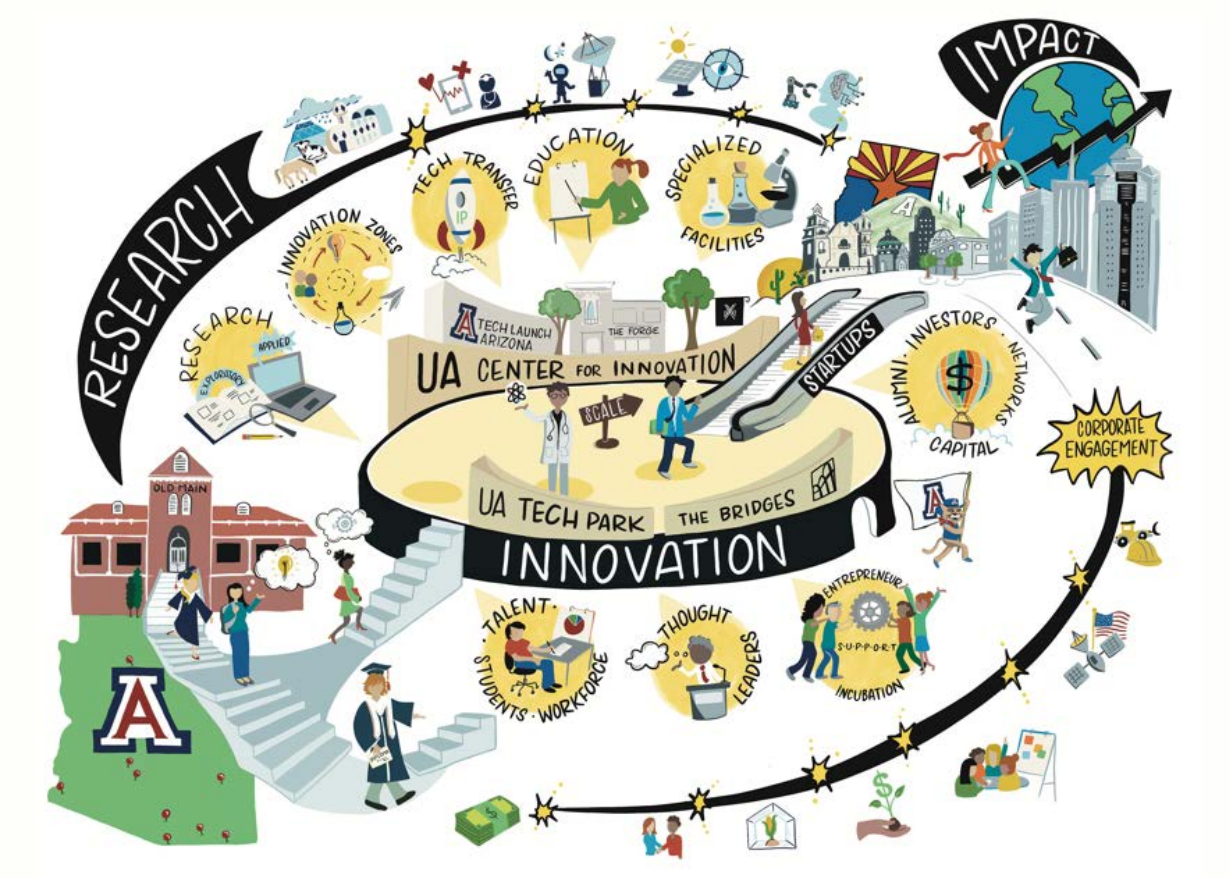


Figure 14. Institutional arrangements and dynamics of Arizona STP. *Source: University of Arizona STP Workshop presentation.*

The Systems has research institutions, innovation zones, technological transfer organizations, educational institutions, and specialized facilities. They also maintain strong links with alumni, investors, and capital risk networks, that in many cases acts as mentors of new startups or future entrepreneurs making significant efforts in the formation of leaders and attracting the best students, researched and people with vocation in business activities.

The networking was mentioned as one of the strategic actions in which lays the ecosystem (Figure 15):

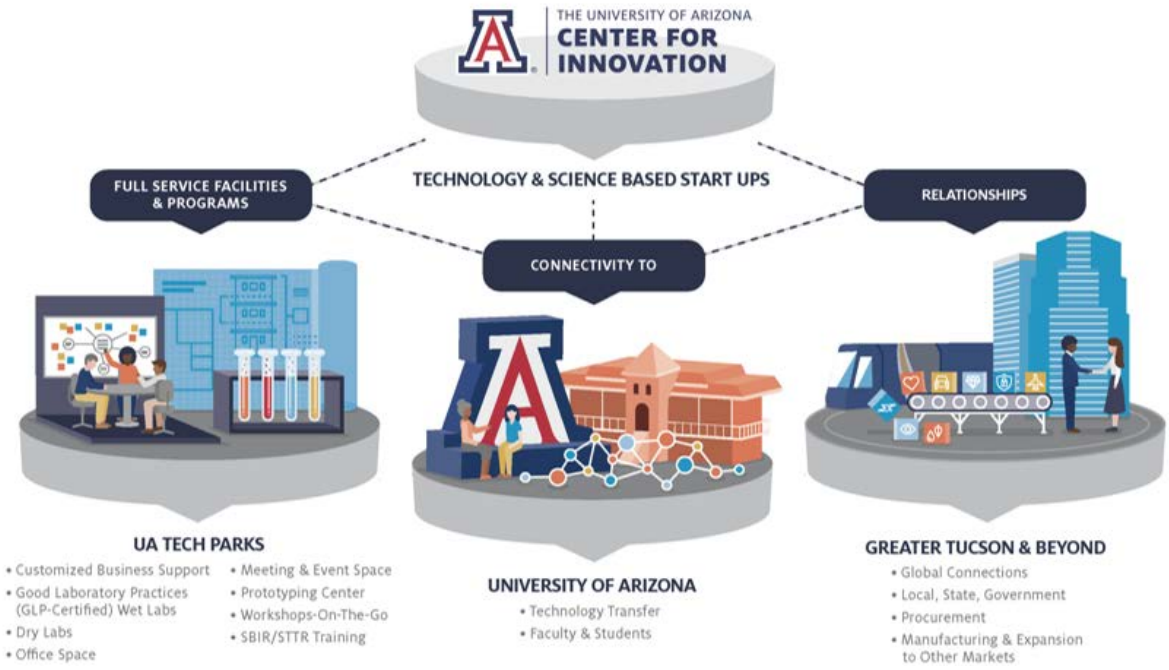


Figure 15. University of Arizona Innovation Center relations. . Source: University of Arizona STP Workshop presentation.

The University links students and researchers with full-service facilities and innovation programs developed in the STP where customized business support is supplied as well as high quality facilities like dry labs, office space, meeting rooms and a prototyping center. The STP is a hub connecting these local capacities to global ecosystems, governments, and abroad markets. The strong links with investors allowed the STP to reach its equilibrium point in less than a year. At the first development stages the STP had governmental support that was quickly overcome by private investments. All the startups in the Center of Innovation go through a structured program that takes them through a continuum process of education provided by mentors, advisors, and community collaborators. The Center provides access to services providers, industry clusters groups, and connections to potential investors, customers, and strategic partners.

The Arizona University also runs a soft-landing program to startups from Mexico but worldwide open with the support of the Department of State. Finally, other strategic activities deal with purposeful efforts to create community, through strong communications programs.

The earlier STP cases from the Asian economies as well as the already presented experience from the Arizona Tech Park, and Nuevo Leon STP from the north American economies are success cases to inspire the ones in developing areas. Improving networking abilities and skills is indeed a key action to be promoted by new STP in Latin-American region to shortcut their internationalization processes connecting with strategic partners in new business and opportunities for the enterprises allocated in their ecosystems.

Strong environment conditions are needed prior to the developing of a new STP. In all cases, decisions should be taken based on a good analysis of the baseline, a correct evaluation of the map of local actors and capacities to generate and/or adapt technologies. The main local production chains should be considered and having in mind since first stages an internationalization strategy. Impact assessment and processes performance evaluation need to be conducted at all stages. In many cases, certification of STP under international standards or accreditation under quality

standards in innovation management (UNE 160000 series) have been cited as trust-generating factors.

Other important aspects presented in the workshop and that should be especially considered from the political-strategic and organizational management spheres, are the excellence of the management staff and the level of leadership of its CEO. They affect the flexibility of the organizational model, the professionalization of the institution, and the reduction of internal bureaucracy and agility to make agreements between parties.

Networking also allows access to instruments developed by international networks that can be useful in the planning stage of TCPs. As an example, we can cite the IASP Strategigram based on software that allows finding the management model of each technology park based on seven strategic axes (Sanz, 2011). The factors that this model considers characterizing STPs are: 1) location and environment, 2) positioning in the technological flow, 3) prioritized companies, 4) specialization, 5) areas of action, 6) networks, and 7) model ownership and management.

Main tools used to address the impact of the COVID-19 pandemic and thereby stimulate economic recovery

R&D&i Management Systems allow companies and organizations, regardless of their size or the economic sector to which they belong, to systematically improve their R&D&i activities, without pigeonholing them into fixed rules that limit their creative processes by supplying useful guidelines for effectively organizing and managing this type of activity.

Several authors have contended that there is a positive relationship between innovation and standardization. Edum-Fotwe et al. (2004)[13] showed how innovative solutions were achieved in the British health sector by standardization, thus maintaining a baseline of reliable performance in health care.

As with other standards, such the ISO 9000 family of quality standards, the UNE 166000 series of standards for innovation management supply the terminology and definitions that other sets of standards that might be developed and implemented apply. Such is the case of the first standard, which was entitled: UNE 166000:2006 R&D&I Management: terminology and definitions of R&D&I activities (AENOR, 2006a).

Subsequently, a second group of standards was developed, which consists of: UNE 166001:2006 R&D&I Management: requirements for a R&D&I project (AENOR, 2006a) and UNE 166002:2006 R&D&I Management: R&D&I management system requirements (AENOR 2006b)

A third group consists of: UNE 166003:2003 EX R&D&I Management: Competences and evaluation of R&D&I project auditors, and UNE 166004:2003 EX R&D&I management: Competences and evaluation of R&D&I management systems auditors.

The second group (UNE 166001:2006 and 166602:2006 R&D&I Management) is the most important in the series because the members of this group represent the standards that organizations can use

[13] Edum-Fotwe, F.T., Gibb, A.G.F. & B. Enford-Miller, M. (2004). Reconciling construction innovation and standardisation on major projects. Engineering, Construction and Architectural Management, 11(5), 366-372.

in their innovation projects and innovation management systems. The Figure 16 summarize the UNE 166000 family standards.

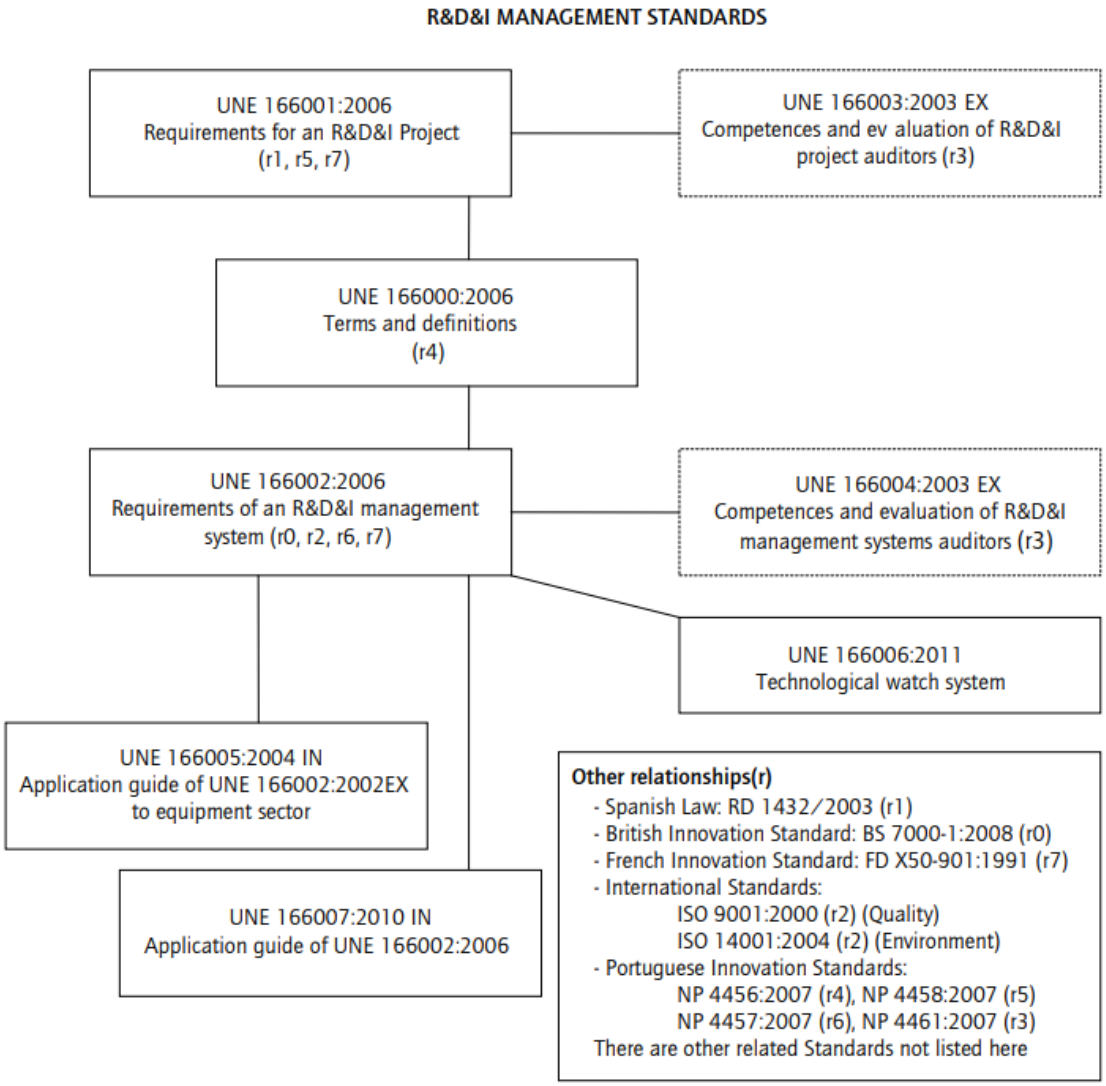


Figure 136. UNE 166000 family standards. Source: Mir, M. & Casadesús, M. (2011)[14].

The main tools to ensure standardized quality levels in this management of STP and supply an added value of confidence in the activity, improving its business image and its competitiveness are:

1. The UNE 166002 standard supplies direction so that there is a greater understanding of the context of the organization, it enables development and expansion of the R&D and Innovation management process, and it improves the performance and evaluation of the system. It presents requirements and practical guidelines for the formulation and development of R&D&i policies, for the establishment of objectives in accordance with the specific activities, products and services of each organization, for the identification of emerging technologies or new technologies not applied in their sector, whose assimilation and subsequent transfer will provide the basis for generating projects, enhancing their products, processes or services and improving their competitiveness.

[14] Standardized innovation management systems: A case study of the Spanish Standard UNE 166002:2006. INNOVAR, 21(40), 171-187.

The Certification of the R&D Management System allows companies:

a. Systematize their R+D+i activities and integrate them into the general management of the company. Plan, organize and control the R+D+i units, as well as the product portfolio generated.

b. Establish the interaction of R&D&i with other departments or divisions.

c. Demonstrate the transparency of R&D&i activities.

d. Encourages improvement in production and therefore, financial return.

e. Encourages inspiration and increased value to the organization.

f. Encourages the identification of commercial risks.

g. Encourages employee motivation and involvement in teamwork.

2. The UNE 166006:2018 Standard "R&D&i Management on Surveillance and Intelligence Systems." It was designed to help implement surveillance and intelligence systems in all types of organizations, as part of R&D&i management, standardizing common terminology and processes to guide action. In the current technological context, It represents a strategic tool to improve decision-making in organizations. It helps to implement systematic processes of capture, analysis, dissemination, and strategic use of strategic information for the anticipation of changes, the reduction of risks and uncertainties or the detection of innovation opportunities, among other advantages.

   Competitive intelligence and project management help by identifying, facing, and managing situations of change and, therefore, maintaining leadership positions. This method provides relevant information, evaluated, and analyzed, oriented to the making and execution of decisions. It especially stresses the prevention of risks and threats and the identification of opportunities, which makes it a useful tool for the design of the organizational strategy and the start-up of operations and the making of actions of influence in the exterior. Definitions of competitive intelligence overlap with definitions of other more established fields of study, like decision sciences and marketing. Competitive intelligence can be applied to the deployment of all managerial functions including strategic intelligence, environmental scanning, customer intelligence, competitor intelligence, marketing intelligence, technical intelligence and supplier and manufacturing intelligence. STP has different models of implementation and can choose to buy of intelligence reports from specialized companies, the creation of an inhouse intelligence department, or total or partial outsourcing of their management. Competitive intelligence is often managed in STP as a core business process to support decision making in innovation-based business opportunities and in intellectual property strategies.

3. Systems ERP (Enterprise Resources Planning). Many STPs use this management software to plan the administration of their businesses. It helps in supplying added value of trust in the R&D&i activity, improving the business image and competitiveness.

   Enterprise Resource Planning (ERP) is one the latest technologies that many organizations have undertaken and integrates all necessary business functions into a single system with a

shared database. These software packages can be customized up to a certain limit to the specific needs of each organization and since the 1990s were characterized as the most important development in the corporate use of technology. As the cost of an ERP implementation project is extremely high, it is critical for a STP follow up the customization of this software according to their business specificities (Figure 17).

ERP system adoption can help the organizations by improving the interaction between the business functions and the information making it more reachable. ERP systems have advantages in information quality and the integration of business processes and operations.

Business function	Decisional area	ERP benefit	The interrelationship between ERP benefits and business processes in dry food packaging industry
SUPPLIER	Strategic	Improve supplier performance	The supplier can track the demand of the company through the data in the marketing department and supply the materials to complete the inventory of the company.
	Tactical	Tying the suppliers to the ERP system	Due to the implementation of the ERP systems in dry food packaging companies, the suppliers also have to implement this integrated information systems; therefore the suppliers can track the data and information of the dry food packaging
	Operational	Real time data access across multiple sites	By implementing the ERP systems, the suppliers can access the data of dry food packaging company.
OPERATIONS & LOGISTICS	Strategic	Generate product differentiation	Based on the customers' demands and the markets, the dry food packaging company can differentiate their products.
	Tactical	Improve the interaction between business units	The ERP systems facilitate the data and information transformation between the entire business units. This ability improves the interaction between them.
	Oprational	Improve order management/order cycle	One of the activities in operations and logistics business unit is to order the raw materials from suppliers. By implementing ERP systems, the operations and logistics can improve their order management.
FINANCE	strategic	Finance information accuracy and faster decision making capability	By having data and information integration in the entire business processes, the finance business unit has finance information accuracy that can support faster decision making capability.
	Tactical	Improve cash management	ERP Financials, you can report, analyse, and allocate cash in real time, and establish in-house banks or payment centers.
	Operational	Decrease financial close cycle	ERP Financials, the dry food packaging companies can streamline accounting, consolidation, process scheduling, workflow, and collaboration.

Figure 17. The example of ERP benefits and their interrelationship to the business processes in dry food packaging industry (Source: Samira Sadrzadehrafi ei et al. 2013[15])

4. Management audits. These instruments periodically measure the efficiency of the administrative management, the fulfillment of the mission and the institutional aims, the plans and the programs, the goals, and the legality. It is a key factor to consider within the management instruments given the primary responsibility of the directors and managers of the organization in reliable performance and in being accountable to society about the destination of the resources granted, their use and impact. The success of management requires complementing the organization's internal and external control strategies[16].

[15] *Samira Sadrzadehrafi ei et al 2013.The Benefits of Enterprise Resource Planning (ERP) System Implementation in Dry Food Packaging Industry. Procedia Technology 11 (2013) 220 – 226*

[16] https://stunitednewsfeed.org/management-audit-concept-and-scope/

The aims of Management Audit are to present recommendations to improve efficiency, detecting incompetency in different sectors and suggesting methods for improvement of efficiencies. It aims at improving productivity at various levels of management and implementation of policies. It is also used to analyze the overall ability of strategies, policies, and planning as well as the policies processes structured by the management.

The Scope of Management Audit is quite broad in comparison to a financial review as it not only analyses the finance but also other aspects of a company. It has the capability to assess management at distinct levels (Figure 18).

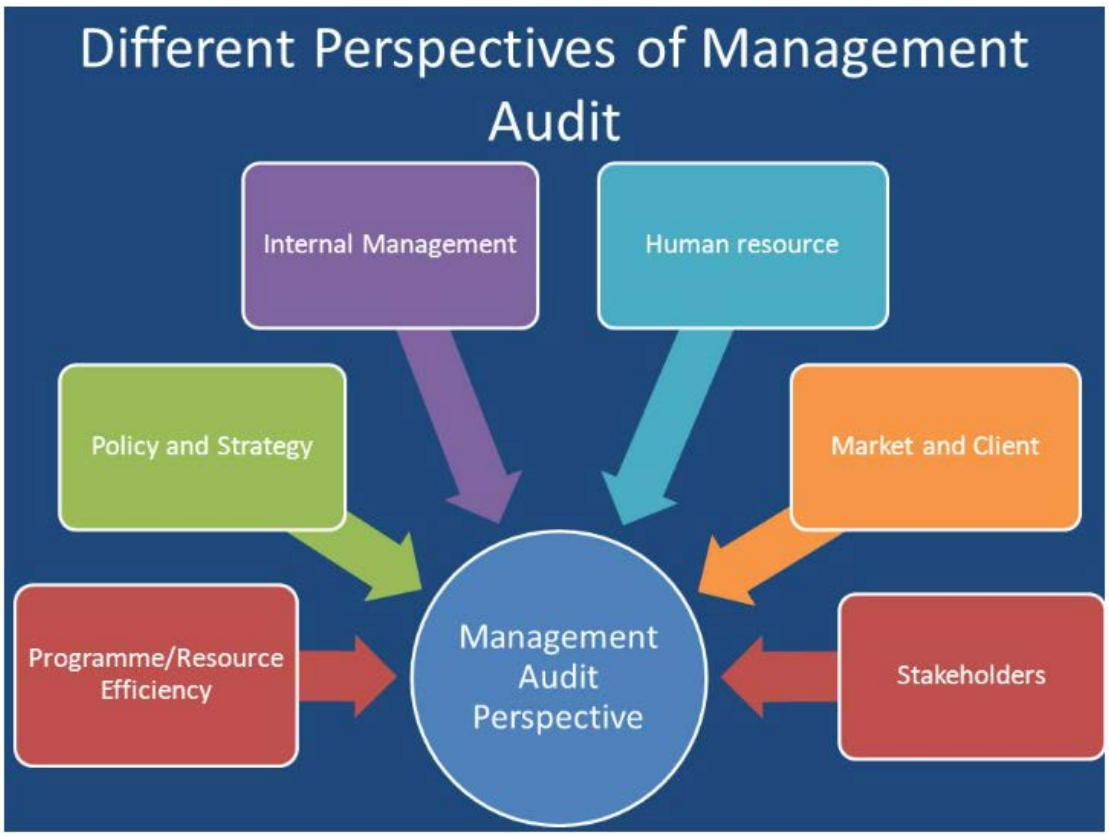


Figure 18. Different perspectives and levels of management audit (Source: https://stunitednewsfeed.org/management-audit-concept-and-scope/).

The Management Audit if it is well performed present many advantages for STP and brings confidence to the directive board. The main reasons are because of being independent and fair, evidence based, transparent and accountable. These attributes are graphically summarized in Figure 19 as well as complemented by others.

Figure 19. Advantages of Management Audit. (Source: https://provisegrclab.com)

5. STP are complex institutions that aim at promoting innovation and entrepreneurship at local level. Their activities entertain a large set of stakeholders going from internal and external researchers to entrepreneurs, local level public administration and universities. Therefore, their performances extend on a large set of dimensions affecting each other. This feature makes Science Parks particularly difficult to be properly compared. However, evaluating their performances in a comparable way may be important for at least three reasons:

   (1) to identify best practices in each activity and allow a faster diffusion of these practices,
   (2) to inform potential entrepreneurs about institutions better supporting start-ups birth and first stages and
   (3) to guide public policies in the distribution of funds and incentives. The multidimensional nature of Science Parks raises the problem of aggregating performances in simple indexes that can be accessed by stakeholders willing to compare different structures based on their own preferences.

   Corporate sustainability, which is the capacity of a firm to continue operating over an extended period, depends on the sustainability of its stakeholder relationships. This new stakeholder view of the firm goes beyond earlier work on the triple bottom line and balanced scorecard. STP need proper systems to measure and control their own behavior to assess whether they are responding to stakeholder concerns in an effective way and to communicate the results achieved. These sustainability accounting systems should have the purpose of broadening and integrating the traditional financial approaches to corporate performance measurement, taking stakeholder needs into due account.
   STPs must define evaluation criteria and indicators, to measure their performance, find problems and opportunities for improvement. This definition of indicators should be conducted once its Mission and Vision have been defined and agreed upon by all the actors involved in governance.

These indicators must be:

a. Specific: achievable and specific points must be marked.

b. Measurable: A metric should always be based on quantification.

c. Achievable: There is no point in setting unattainable marks or quotas when measuring a process.

d. Relevant: important and decisive for the business of the ecosystem.

An example of STP key performance indicators is presented in Table 3.

Table 3. STP performance indicators (Source: UNIDO, 2021)[17]

STP implementation indicators	STP outcome indicators	STP impact indicators
• Area of land developed and building pace constructed. • Number of companies located at the park. • Number of companies "graduated" from the STP. • Rental and services income (Monthly and yearly earnings). • Type and range of typical services provided by the park.	• Amount of capital raised (i.e., public and private investors). • Total amount of investment in R&D. • Number of local suppliers and workforce. • Number of high-quality workforce available. • Number of products/services developed by tenants. • Number of technology transfer agreements. • Cooperation agreements established.	• STP contribution to high-technology production. • Number and type of employment generated (i.e., number of qualified scientists and engineers employed). • Exports share related to the operation of the park. • Intra-industry structural change rate (share of high-tech activities within MVA). • Wage increases of STP workforce compared to national wages.

The following categorization is chosen for listing the relevant STP attributes: proximity, real estate, and managerial attributes. Each SP attribute in these three categories is expected to lead towards potential benefits for the tenant firms based on previous studies (Wei Keat Bennyet al. 2021)[18]. Many beneficial performance dimensions are derived from empiric STP research comparing on-park with off-park firms. Firstly, economic benefits that firms perceive include attracting funding for growth/innovation, attracting human talent, increased sales of new products (new to the organization and new to the market), increased profitability, and cost savings. Secondly, innovation benefits are new patents/licenses, new products/services, increased research contracts, and increased R&D investments. Lastly, networking benefits, are developing formal and informal ties

17 https://hub.unido.org/sites/default/files/publications/Publication_%20New%20Generation%20of%20STI%20parks_2021.pdf

18 W.K.B. Ng et al.2021.Technological Forecasting & Social Change 163 (2021) 120408

(e.g., joint research contracts, social networking) with other firms, research institutes or the university (Wei Keat Bennyet al. 2021).[15]

Proximity attributes

The high physical proximity between knowledge-intensive actors contributes to socialization, economies of scale, sharing information, mutual learning and increased innovative output. The proximity attributes consist of the geographical proximity to various actors: university, research institute, similar firms, well-known firms, competitors, new customers, and existing customers.

Real estate attributes

SPs as an area development supply infrastructure, facilities and services to tenant firms The following real estate attributes are identified from literature: R&D facilities, supporting facilities, services and firms, shared facilities, flexibility/expansion possibilities, pricing of the facilities and services and image of the SP

Managerial attributes

SP management (when present) varies from an on-site management company, single on-site manager, or informal team, although the former is more common in the European SP context. The managerial attributes consist of the SP management itself and its activities: applying selection criteria, creating a communal atmosphere among tenants, granting access to regional and international networks, promoting an entrepreneurial climate, and lastly providing the ease of access to innovative ideas, skills, or knowledge on the park.

Main tools used to adaptation to the 4th Industrial Revolution

The success stories presented and the discussion process in the three thematic axes of the Workshop showed that the main lessons and instruments adopted by micro and medium-sized companies to adapt to the post-COVID 19 health crisis are valid for STPs. Those identified by Bai, M. Quayson and J. Sarkis, (2021) that were previously presented in Table 1, referring to process automation, virtualization of management processes, energy efficiency, strengthening of networking and search for internationalization. of services and businesses. Other instruments used by the STPs in adapting to the paradigm changes of the fourth industrial revolution point to the diversification of their activities and target sectors, the inclusion of added information and communication technologies for their virtualization, training of human resources for provide them with the new skills required by the processes of change and quality management to search for continuous improvement. In these respects, many STPs have redefined their business models and restructured their organizational models seeking flat pyramids, greater flexibility, and teamwork under less bureaucratic rigidity.

The enterprises and startups allocated in STP ecosystems are adopting many actions to take prove of the industries 4.0 new business opportunities. A recent organizational study on technological readiness (Deloitte, 2020)[19] showed that most organizations are prioritizing actions in training and developing their workforce, making a profit while positively contributing to society and understanding what skills will be needed. A second set of organizations adaptative initiatives to

[19] https://www2.deloitte.com/content/dam/Deloitte/de/Documents/human-capital/Deloitte_Review_26_Fourth_Industrial_Revolution.pdf

paradigm changes deals with having a connected, integrated approach to implement industry 4.0 techniques and developing innovative differentiated product and services. Attracting and retained de right talent challenges the whole ecosystem because this is directly associated with disruptive competition models and the use of technology with societal positive impact (Figure 20).

The previously referenced study shows that organizations continue to contend with ensuring that their workforces own the skills needed to succeed in an Industry 4.0 environment; only a fifth of executives completely agree that their organizations are currently ready, a drop of about five points from two years ago. Concerns about workforce readiness for Industry 4.0 are exceptionally acute in Asia and the Americas, where only 4 percent and 9 percent, respectively, agreed they had the skills needed.

With respect to attracting qualified talent from the outside, 79 percent of executives who prioritize this issue said they are making either some or a great deal of progress. Given the rapid pace of Industry 4.0, hiring for "mindset" rather than skills may be the key to longer-term talent success, given those people with open and flexible mindsets can be trained on an ongoing basis to adapt to the organization's changing needs (Deloitte 2020 *op cit*.).

Technological Business Incubators organizational models are also challenged not just because of the need to attract new talent but also to think in new services and ways to give support to disruptive startups using innovative technologies.

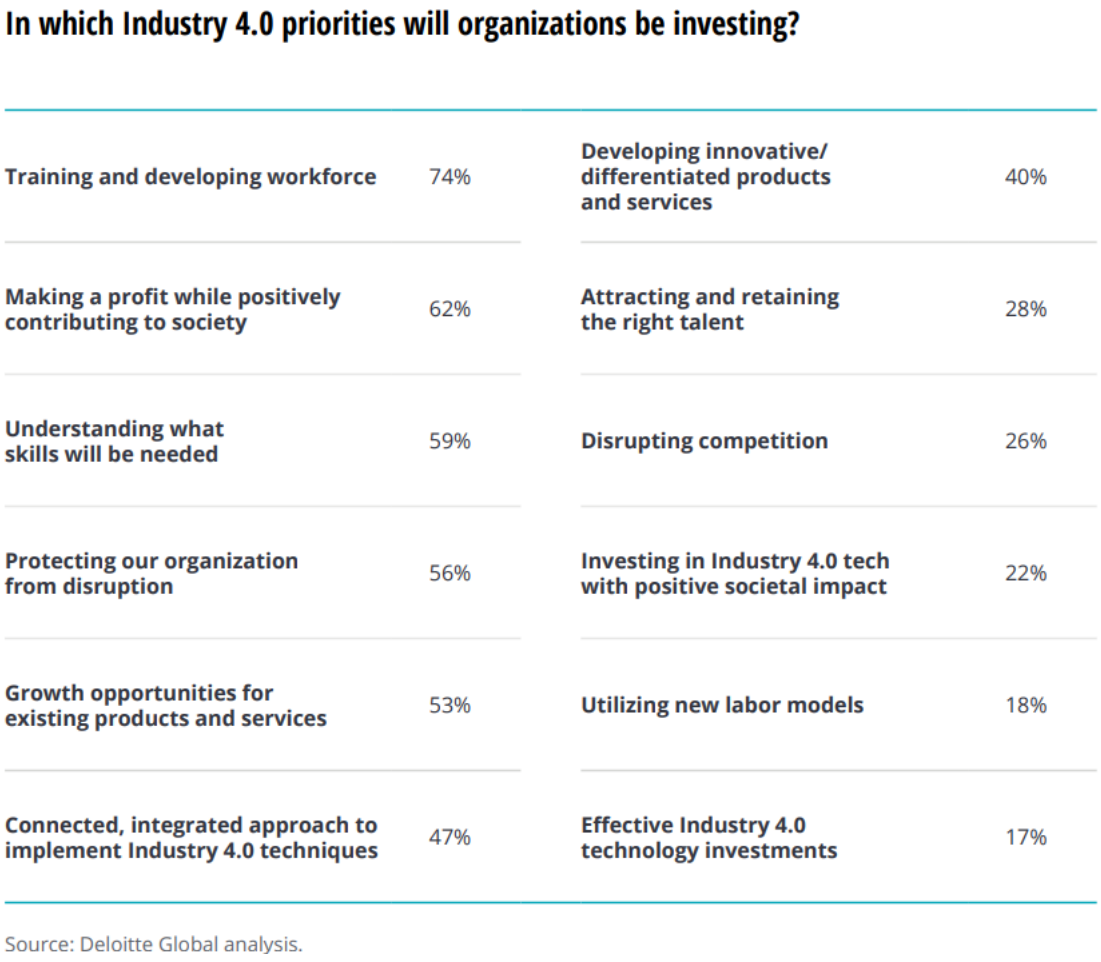


Figure 20. Industry 4.0 priorities on which organizations are investing (Source: Deloitte Global analysis).

Emerging markets should promote capital streams to foreign investment, for reducing a global downturn risk, which aims its activity to the twelve emerging technologies in the fourth industrial

revolution. These are critical drivers for sustainable economic development, that not only will face technological aspects but also, they can pave the way to achieve sustainability (Guadalupe et al., 2020)[20].

Although Industry 4.0 is an excellent opportunity for all stakeholders in the goods and services production, it also stands for a threat to lagged economies in technology development. The technologies that are being most often using by new startups deals with the Industrial Internet of Things (IIoT), Cybersecurity, the cloud, additive manufacturing, augmented reality, big data analysis, autonomous robots, and simulation. There are in common 6 of 12 emerging economies with I4.0 technologies denoted in Table 4 that are transforming STP environments.

Table 4. Common Emerging and I4.0 technologies

Emerging technologies	*I4.0 technologies*
Additive manufacturing (3D printers)	Additive manufacturing
Artificial intelligence and robotics	Autonomous robots
Blockchain and distributed ledge	Blockchain*
Internet of Things device technologies	Industrial Internet of Things (IIoT)
New computing technologies	The cloud, Big Data analysis & Simulation
Virtual and augmented technologies	Augmented reality

[20] http://www.ieomsociety.org/detroit2020/papers/354.pdf

ANNEX I. SUMMARY OF THE WORKSHOP

Selection of main Speakers, moderators, and STP success stories.

It was agreed with CONCYTEC that it will select 6 STP of high performance to share their experiences and to present inputs for a discussion with participants to find and remarks the learned lessons and best practices for the industry. A high-level representative from each one would be selected as a speaker, and best efforts would be done to invite and select moderators from APTE (Science and Technology Parks Association from Spain), IASP (International Association of Science and Technology Parks and Innovation Areas) and AURP (Association of University Related Research Parks). A fourth moderator would be proposed by CONCYTEC for opening sessions and presenting the activity as well as the involved authorities.

After more than ten meetings with potential speakers and moderators six speakers and 6 STP were selected and approved for participation by the CONCYTEC and APEC (Table 5)

Table 5. STP selected as Study cases according to the defined criteria.

STP	ECONOMY	WEB PAGE	CEO
TUS PARK	CHINA	http://en.tusholdings.com/h/tuspark/	Herbert Chen
ARIZONA TECH PARK	USA	https://techparks.arizona.edu/	Carol A.Stewart
MALAGA STP	SPAIN	https://www.pta.es/	Felipe Romeras
NUEVO LEON STP	MEXICO	https://www.nl.gob.mx/campanas/parque-de-investigacion-e-innovacion-tecnologica-piit https://i2t2.org.mx/	Martha Leal
TECNOPUCS	BRAZIL	https://tecnopuc.pucrs.br/	Jorge Audy
THAILAND STP	THAILAND	https://www.sciencepark.or.th/	Suwipa Wanasathop

Brief description and fundaments for study cases selection (Why these STPs?).

Tech Parks Arizona creates the place, environment, and interactive ground that generates, attracts, and retains technology companies and talent in alignment with the research, mission, and goals of the University of Arizona (UA). Tech Parks Arizona directs the UA Tech Park at Rita Road, UA Tech Park at The Bridges, and the University of Arizona (UA) Center for Innovation with the highest priority of recruiting companies with connections to the UA to locate at these facilities. This Tech Park has awarded many awards and recognitions that can be checked here: https://techparks.arizona.edu/about-us/awards-recognition

Tus Park: TUS Holdings ("TUS") is the university-owned enterprise of Tsinghua University. As a holding corporation managing assets valued over US$30 Billion and a controlling shareholder/shareholder of over 800 enterprises, TUS has established the world's largest global innovations ecosystem with over 200 innovation bases that have incubated over 5000 enterprises. TUS developed a model integrating incubation services, financial investment, entrepreneurship training, open innovation, and an end-to-end financial service platform. It invests in and runs some of China's leading corporations in environmental protection, new energy, healthcare, new materials, and other strategic emerging industries. TUS has three main types of business platforms for enterprises: TusStar Incubators, TusParks, and TusCities. These are spread over 50 cities, such as Beijing, Shanghai, Shenzhen, Guangzhou, Suzhou, and more, making it China's biggest innovation ecosystem.

The **Technology Park of Andalusia**, it is a Digital Innovation Hub that constitutes an ecosystem made up of SMEs, large companies, startups, researchers, incubators, etc., whose objective is to provide the best infrastructures and services to help companies to be more competitive in relation to their business and production processes, their products, or their services, using digital technologies. It has Validation and Testing Services and Infrastructures (DIH Competence Centers): Center for Supercomputing and Bio innovation of the University of Malaga (UMA), houses the Andalusian Institute of Advanced Automation and Robotics (IA3R), the Andalusian Center for Nanomedicine and Biotechnology (BIONAND), to the Test Area for connected vehicles of DEKRA, and to the R&D Laboratory to test 5G solutions and V2X vehicle technologies promoted by Telefónica and DEKRA. It also has a Research Results Transfer Office (OTRI) in its facilities that performs the function of finding the results generated by the research groups of the University of Malaga that may be of interest to companies. The learned lessons from this ecosystem could help many STP from Latin America which are at deployment stage and improving their business plans.

Nuevo Leon Research and Technological Innovation Park (PIIT):

Operated by the Nuevo León Institute for Innovation and Technology Transfer, the PIIT has an area of 110 hectares with world-class infrastructure and services where more than 30 institutions - between public and private- dedicated to R&D&i converge., as well as the development of technology-based companies. It is expected that by 2025, there will be more than 50 Research and Development Centers in operation.

The PIIT is one of the strategies of the Nuevo León project: Promoting the Knowledge Economy and Society, which has among its long-term objectives to increase GDP per capita in the economy, through the transformation of an industry based on manufacturing to a based-on knowledge, in addition to promoting the culture of innovation and entrepreneurship with high added value. This STP, found in the municipality of Apodaca, Nuevo León, has 38 research centers and 2 high-tech business incubators.

It is an active member of the international associations Association of University Research Parks (AURP) and International Association of Science Parks (IASP), which incorporate the most renowned scientific-technological parks in the world, which allows a continuous exchange of experiences for the consolidation of the park.

Tecnopucs: This STP is an innovation hub that's planning to become in an Area of Innovation of Porto Alegre city in the south of Brazil. It brings together innovative talents and companies with the purpose of developing businesses in the verticals: Health, Artificial Intelligence and Data Science,

Agribusiness, Mobility, Education, Social and Food. They are aimed at the interaction between entrepreneurs, startups, consolidated companies, research centers, innovation laboratories, investors, and other agents in physical and digital environments. The hubs work collaboratively to promote interaction and the identification of business development opportunities. They leverage the innovation strategy in accelerating startups and new businesses in Tecnopuc's 4 areas of activity: Information and Communication Technology, Energy and Environment, Creative Industry and Life Sciences. This STP has promoted the installation of the following innovation hubs: 1) BioHub in cooperation with the Brain Institute – InsCer, Hospital São Lucas – HSL and the University Schools. 2) +Healthplus, a health cluster that operates digitally and face-to-face, led by Tecnopuc and Grow+. 3) NAVI, an Artificial Intelligence and Data Science hub led by Tecnopuc and Wisidea Ventures, an accelerator for technology-based companies. 4) Celeiro, an Agro Hub led by Tecnopuc, Anlab and Ventiur Acceleradora to connect producers, suppliers, cooperatives, startups, researchers, and investors in the agribusiness sector. 5) Farol, a Social Hub, which connects the University's innovation, entrepreneurship ecosystem and companies, civil society organizations and public authorities to act collaboratively to foster social development. 6) Cumbuca, a Food Hub, led by Tecnopuc, connects people, organizations, and disruptive food startups to generate opportunities for entrepreneurship, innovation and impact through science and technology. 7) Hub EduX a hub to develop innovative solutions in the education sector connecting them with the market.

Thailand STP:

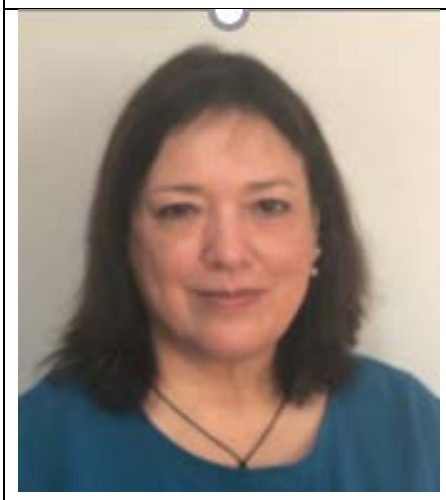
Thailand Science Park (TSP), the economy’s first science and technology park, set up its first phase in 2002 with the mission to promote innovation development and R&D activities in the private sector. TSP builds the ecosystem to promote and support R&D linkage between government and private sector and stimulate the creation of innovative technology businesses.

Thailand Science Park, covers 140,000 square meters of built-up space, and it is fully occupied by the National Science and Technology Development Agency (NSTDA), its four domestic research centers, namely National Center for Genetic Engineering and Biotechnology (BIOTEC), National Metal and Materials Technology Center (MTEC), National Electronics and Computer Technology Center (NECTEC), National Nanotechnology Center (NANOTEC) and National Energy Technology Center (ENTEC) and over 110 corporate tenants, of which 30 percent are international companies. This proximity supplies an opportunity for corporate tenants to gain access to highly skilled personnel, including 2,000 full-time NSTDA researchers, of whom some 700 are Ph.D. scientists.

Keynotes Speakers

Name of Speaker	Short Bio
 Carol A. Stewart: Associate Vice President, Tech Parks Arizona	Stewart's expertise in university research parks spans decades and economies with more than 20 years of experience working with research parks, technology commercialization, business incubation, governmental relations, and business development. As a pioneer in the research parks world, she has driven domestic policy, standardized programs, created domestic and international networks, built technology clusters, engaged stakeholders, and assisted economies with the development of their domestic science and technology policies. Stewart is member of the Southern Arizona Leadership Council, Flinn Foundation Steering Committee, and of the Canadian Global Mentor Program. She also serves on the Board of Directors for Tucson Metro Chamber of Commerce, Pima County's Workforce Investment Board, Sun Corridor Inc., Arizona Technology Council, Desert Angels, and is a member of the City of Tucson Mayor's Economic Development Advisory Council. She is the North American Division President for the International Association of Science Parks and Areas of Innovation (IASP). IASP is the worldwide network of science parks and areas of innovation that gathers 397 members in seventy-three economies. Previously, Stewart served as the Chief Executive Officer of the Association of University Research Parks (AURP), which represents two hundred research parks (80% US and 20% international).
 Hebert CHEN	Herbert CHEN studied in the Department of Engineering Physics of Tsinghua University in Beijing and obtained a bachelor's degree in engineering in 1979. In 1984, worked in Tsinghua University and successively acted as Secretary General of the Student Union of Tsinghua University. In 1988, worked in the Shanxi Provincial People's Government and acted as the Secretary of the Vice Governor. In 1991, he studied in the Energy and Economic Planning Department of UN Asian Institute of Technology and obtained a master's degree in engineering. In 1992, he successively worked in Thailand TM Industry Group and NEC Australia and respectively acted as technical factory director, senior engineer, etc. In 2001, he returned to China and joined the Tus Park management team, functioned as the vice director of Tus

Senior Executive Vice President Tus-Holdings Co., Ltd.	Park Development Center, successively took charge of the daily operation of President Office, Human Resource Department, International Affairs Department, Park Service Department, Branding and Public Relations Department and Tus-Research Institute for Innovation. At present he also acts as the following social positions: President, International Association of Science Parks, and Areas of Innovation (IASP). Member of World Innovation Technology Alliance Advisory Committee and Member of the WTA World Science and Technology Review Editorial Committee
 Felipe Romera General Director of the Technological Park of Andalusia (Malaga TechPark)	Felipe Romera (Soria, 1954) has directed the Andalusian Technology Park (PTA) in Malaga since 1990 and since 1998 he has been president of the Association of Science and Technology Parks of Spain (APTE). In addition, he was a member of the Advisory Council for Science and Technology of the Ministry of Science and Technology on behalf of the APTE (2001-2004) and president of the Network of Technological Spaces of Andalusia (RETA) from its constitution in April 2005 until 2015. He is a Telecommunications Engineer from the Higher Technical School of Telecommunications Engineers in Madrid, where he graduated in 1976. After finishing his studies, he worked at Intelsa (Ericsson), Secoinsa and Fujitsu Spain, working on the design of telecommunications products and, between 1982 and 1993, he was director of the R&D Laboratory of Fujitsu Spain in Malaga. At the same time, he has held and holds positions in the International Association of Technology Parks (IASP). From 1993 to 1998 he was a member of the World Board of Directors, from 1996 to 1998 he was Secretary General of the IASP European Section and from 1998 to the present he is an advisory director of the IASP World Board of Directors. On the other hand, from 1987 to 1996 he was secretary of the Social Council of the University of Malaga.
 Eduardo Matozo	General Manager of the Litoral Centro Technology Park since 2018. LCTP is part of an urban ecosystem, in which the scientific-technological, government and business sectors associate to support the growth of technology-based companies with a high innovative profile. Furthermore, he was minister of the Ministry of Science, Technology and Productive Innovation of the Province of Santa Fe, Argentina between 2015 and 2017. The Ministry was created based on what was previously the Secretary of State for Science, Technology and Productive Innovation. In addition, he had been for 11 years Secretary of Technological Linkage and

CEO STP Litoral Centro Technology Park	Productive Development for National University del Litoral, Santa Fe, Argentina.
 Martha Silvia Leal González Director, Planning, Postgraduate, Dissemination and International Cooperation. - Institute of Innovation and Technology Transfer of Nuevo León. Monterey, Nuevo Leon	She has a degree in Industrial Chemistry from the Autonomous University of Nuevo León and a doctorate in Inorganic Chemistry from the University of Sheffield, in England. She has accredited courses from the Practicing Law Institute for the Patent Agent certificate exam and Advanced Claim Drafting, and from Boston University on Project Management. She has been a professor at the Faculty of Chemical Sciences of the UANL and coordinator of the master's degrees in Sciences at the Universidad Regiomontana. She has served as project manager for VITRO-TEC, at VITRO, SA, and as an external consultant for the She has served as an advisor to various companies in innovation, patent analysis and competitive intelligence. She currently holds the position of director of Planning, Postgraduate, Dissemination and International Cooperation at the Institute of Innovation and Technology Transfer of Nuevo León.
 Jorge Audy Superintendent of Innovation and Development at PUCRS.	PhD in Information Systems at UFRGS (2001), with Post-Doctoral at IASP (International Association of Science Parks and Innovation Areas), at Tsinghua University, China and University of Malaga, Spain (2016). Professor at the Polytechnic School and at the Graduate Program in Computer Science. He is the Innovation and Development Superintendent at PUCRS and TECNOPUC. He was President of FOPROP (Forum of Pro-Rectors for Research and Graduate Studies of Brazilian Universities), IASP Latin America (International Association of Science and Technology Parks and Innovation Areas) and ANPROTEC. Researcher in the areas of Software Engineering and Information Systems. He has experience in Science, Technology & Innovation Management, in the areas of Social and Environmental Impact Business, Innovation Ecosystems (Scientific and Technological Parks) and University, Business & Government Interaction.

 Suwipa Wanasathop CEO Science Park of Thailand	Suwipa Wanasathop is the Vice President of the National Science and Technology Development Agency (NSTDA), and the Director of Thailand Science Park. NSTDA is a domestic scientific and technological solution provider for Thai businesses, with five domestic research centers (BIOTEC, MTEC, NECTEC, NANOTEC, ENTEC) and over 2,000 researchers in-house. She is responsible for driving Thailand Science Park to be a robust and strategic innovation platform for the economy and a home for Science, Technology, and Innovation-based companies. Her aims are to provide easy and efficient access for startups and SMEs to use the knowledge, research, and technology to grow their businesses competitively and sustainably. She develops alliances among research institutions, universities, and private sectors both domestically and internationally.

Moderators

Moderator	Short Bio
 Fernando Amestoy Former President IASP Latin-American Division. CEO STP of Pando, Uy	Fernando Amestoy holds a PhD in biological sciences, a diploma in Information Systems and a postgraduate degree in science, technology, and innovation management. Since April 2012, is Director of the Technological Pole of the School of Chemistry (UDELAR) (www.polotecnologico.fq.edu.uy) and President of the Pando Science and Technology Park (Canelones, Uruguay) (www.pctp.org.uy). In the last 20 years took part in science, technology, and innovation programs, supported by the IDB, the World Bank, the Food and Agriculture Organization of the United Nations (FAO) and the Program of the United Nations for Development (UNDP), working as an international consultant on these issues. Between 2017 and 2021 integrated the Board of Directors of the International Association of Science Parks and Innovation Areas (www.iasp.ws), was also Director of the IASP Latin American Division.
 Juan Pablo Suarez President IASP Latin-American Division. CEO STP Universidad Técnica Particular de Loja, Ec	Dr. Suarez is titular professor at the UTPL, is the chief of the Ecology and Evolution of Microbials Systems Research Team. Leader researcher in many research projects related with plant and microorganism interaction, molecular ecology, and biodiversity. He has published more than 40 papers in indexed scientific publications.

 Cristina Montero CEO Khem Biotech Business Incubator, Uruguay	Cristina Montero is the manager of the Khem business incubator in Uruguay, where she promotes, supports, and advises on the development of innovative companies based on scientific knowledge. Cristina has a Master of Business Administration from Drexel University (Philadelphia, Pennsylvania). She has a major in International Business (BA in Economics and International Studies, from Texas A & M University, College Station, Texas). She has more than 10 years of experience in moderating entrepreneurship and regional cooperation events.

Semi Structured guide for moderators

AXIS 1	AXIS 2
1. How relevant is the contribution of experiences shared by international organizations such as the IASP in the development of its strategic plan, internationalization of services and/or new business plans? (E.g.: the IASP Strategigram, methodologies, standardization processes, international cooperation benchmark and evaluation, etc.). 2. What is the weight of the business sector in the development of the strategy, and how do companies and academia participate in it? 3. How relevant is the contribution of the government in the financing and sustainability of the ecosystem?	1. What do you consider to be the key factors to achieve the sustainability of the ecosystem: greater support from public policies, innovation in the organizational model, increase in business sophistication? Others. 2. What has been the planned strategy in the post-pandemic stage to increase the competitiveness of your ecosystem and make it more attractive to receive investment, establish or develop new companies?

AXIS 3

1. How can STPs strengthen their role as local connectors with global innovation ecosystems to take advantage of the new opportunities brought by the 4th industrial revolution and adapt or overcome risks and threats?
2. How do you evaluate the results of the strategies developed to connect with other ecosystems to search for new businesses and opportunities?
3. Do you consider the role of the STP to be important as a catalyst for R&D&i in the region, serving, in addition to technological innovation, environmental issues or sustainable development (SDG)? Is there government support in your ecosystem to promote this type of action?

Survey structure is presented in :
https://docs.google.com/forms/d/1oepfAKP0rF3XscewTP4UV5ukUOPas4ew1enmfmgdqZM/edit

Findings and conclusions from the Virtual Conference

Axis I: Implementation of science and technology parks: planning, strategy design and minimum standards.

In this session two presentations were held, one from a more developed economy and the other one from a less mature economy, on implementing, planning, strategy design and minimum standards on STP. This was based on the experience of the Province of Santa Fe in Argentine and the STP of Arizona (USA) presented by their CEOs, Eduardo Matozo and Carol Steward.

Summary of Eduardo Matozo presentation:

The STP of Santa Fe, Argentina, is 20 years old and although it was born in the 1990s, it only managed to consolidate in 2002. It is a public limited company with majority state participation with a triple helix steering structure in which the government, the academic (National University of the Litoral and CONICET) and business chambers interacts. The profile of this STP is biotechnological, and it is focused on human, environmental and agricultural health. They also have strategic lines directed to tics, nanotechnology, and scientific-technological services. Its specificity seeks to take advantage of the original knowledge creation capacities available in its region and of the main local production chains demands. Matozo also presented de governance structure of its STP where 9 members share the steering committee. This works under a triple helix approach where the Universidad Nacional del LItoral, the Government of the Santa Fe province and the

industry and commercial sector share responsibilities. There is also an Executive Board in charge of the management of ordinary and / or urgent matters that are not advised to be deferred for the next Board meeting, and the execution of the acts or steps entrusted to him by the Board, and which may be delegated following current legislation.

In this STP the first and third exporting companies in the region are distributed and represent 41% of the exports of the city of Santa Fé. They are also an important source of specialized employment in the region having 500 jobs in house and high-quality employment (60% university degree and 10% completely postgraduate). The governmental support was fundamental to achieve these results and despite the STP receive a canon and occasionally subsidies depending on competitive funds, it is not enough to achieve economic independence. The object of governmental intervention is the promotion of regional development with environmental sustainability.

From the Latin American economies contrasts the presentation of less developed ecosystems where universities are often key players in the creation of STP but without sufficient governmental support for these projects.

Improving the relationship between the university and the government are necessary conditions, but not sufficient to ensure sustainable development. It is also needed to involve the social actors of the region, and an institution with strong leadership to coordinate actions, and bringing the parties together. In the case of Litoral de Santa Fe STP, this role was fulfilled by the university, which had to work on legal engineering to enable other actors to become part of the ecosystem. When it is possible to show business success stories, it is easier to attract new companies and investments.

The government support despite in a more restricted dimension than in developed economies was also remarked as a key factor in province of Santa Fe, in Argentina ecosystem, which has 800 km of coastline on the Paraná River. In this case, a program launched by the Government to subsidize the preparation of the strategic and local development plan for STPs, and business incubators was well evaluated.

Summary of Carol Stewart presentation:

The University of Arizona Technology Park showed results of many years of experience in developing and running these organizations. The University is in the core of the ecosystem and was the key institution in promoting actions to improve the interaction with the productive sector.

the University of Arizona STP, which is a hub that can link enterprises all over the world and connecting with investors, technological centers, or open innovation opportunities.

The University of Arizona innovation ecosystem is based on two Tech Parks and a Center for Innovation. The region where it is found has strong connections with logistic strategical facilities like the Tucson International Airport and to important highways. Tech Parks Arizona creates the place, environment, and interactive ground that generates, attracts, and keeps technology companies and talent in alignment with the research, mission, and goals of the University of Arizona (UA). Tech Parks Arizona directs the UA Tech Park at Rita Road, UA Tech Park at The Bridges, and the University of Arizona (UA) Center for Innovation with the highest priority of recruiting companies with connections to the UA to find at these facilities.

Tech Parks Arizona is deeply aligned with the research, mission and goals of the University of Arizona, a world-class Tier One research university. Companies can use the University of Arizona’s knowledge and resources to provide innovative solutions to today’s global challenges.

The University of Arizona (UA) is a premier public research university. The University is recognized as a world leader in research and innovation with ability in advanced energy, defense and security, bioscience, mining technology, arid lands agriculture and water, and intelligent transportation systems and smart vehicles.

UA was set up in 1885 and receives more than $687 million annually in research funding. The National Science Foundation ranks it #22 among the top public universities and colleges. As the state's land-grant institution, it has offices in every economy and more than 500 community outreach programs statewide.

The University of Arizona Science and Technology Park (UA Tech Park) and The UA Tech Park - The Bridges, are owned by the Arizona Board of Regents (ABOR) on behalf of the University of Arizona (UA). The development, operation, marketing, and leasing of the parks are managed through the Campus Research Corporation (CRC). The University was aided in the acquisition of the UA Tech Park by the Arizona Research Park Authority (ARPA).

The Systems has research institutions, innovation zones, technological transfer organizations, educational institutions, and specialized facilities. They also keep strong links with alumni, investors, and capital risk networks, that in many cases acts as mentors of new startups or future entrepreneurs making significant efforts in the formation of leaders and attracting the best students, researched and people with vocation in business activities.

The University links students and researchers with full-service facilities and innovation programs developed in the STP where customized business support is supplied as well as high quality facilities like dry labs, office space, meeting rooms and a prototyping center. The STP is a hub connecting these local abilities to global ecosystems, governments, and abroad markets. The strong links with investors allowed the STP to reach its equilibrium point in less than a year. At the first development stages the STP had governmental support that was quickly overcome by private investments. All the startups in the Center of Innovation go through a structured program that takes them through a continuum process of education provided by mentors, advisors, and community collaborators. The Center supplies access to services providers, industry clusters groups, and connections to potential investors, customers, and strategic partners.

The Arizona University also runs a soft-landing program to startups from Mexico but worldwide open with the support of the Department of State. Finally, other strategic activities deal with purposeful efforts to create community, through strong communications programs.

Summary of the Axis I Discussion panel

Eduardo Matozo and Carol Stewart were joined in the discussion session by Ana Sobarzo (director of the department of innovation and entrepreneurship at the Cayetano Heredia University in Peru) and Carlos Cardenas (director of the regional institute of technology and innovation of the government of Piura, Peru).

From the Latin American economies contrasts the presentation of less developed ecosystems where universities are often key players in the creation of STP but without sufficient governmental support for these projects. This situation is similar in most of the Latin American economies where the insufficiency or absence of specific support instruments for STI and industrial development policies is a problem to deal with. This is even worst in the case of Latin-American private

universities where the lack of public funding makes difficult to create STPs or innovation districts. Although in many cases the universities compete for public funds or subsidies and succeed in obtaining support this is not enough for infrastructure building.

These particularities are fully aligned with the vision presented from the Argentine experience while an example mentioned the STP infrastructure was modular based on containers. Given these limitations in public financing, the strategies should be focused on seeking greater involvement of private capital at the domestic level and in cooperation between the APEC economies. The priority in Latin-American STP was put not just in infrastructure growth, but to focus on RIS3, and in promoting of regional development.

In the discussion session, some appreciations were made on the fact that promoters from various sectors are needed in STP creation, since the effort of a university, the regional government, or an isolated industry alone are enough. According to the experiences presented, the alignment of all the actors with a common vision is necessary to shape governance as well as a strong leadership.

Improving the relationship between the university and the government are also necessary conditions, but not sufficient to ensure sustainable development.

Axis 2: Management of science and technology parks aligned with sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery.

In this session two presentations were held, one from a more developed economy and the other one from a less mature economy, on sustainability, digitalization, inclusion of SMEs and post-COVID-19 economic recovery. These topics were focused based on the experience of the Tecnopuc STP (Brazil) and from the Thailand STP (Thailand).

Summary of Jorge Audy presentation

This STP is an innovation hub that is planning to be become in an Area of Innovation of Porto Alegre city in the south of Brazil. It brings together innovative talents and companies with the purpose of developing businesses in the verticals: Health, Artificial Intelligence and Data Science, Agribusiness, Mobility, Education, Social and Food. They are aimed at the interaction between entrepreneurs, startups, consolidated companies, research centers, innovation laboratories, investors, and other agents in physical and digital environments. The hubs work collaboratively to promote interaction and the identification of business development opportunities. They leverage the innovation strategy in accelerating startups and new businesses in Tecnopuc's 4 areas of activity: Information and Communication Technology, Energy and Environment, Creative Industry and Life Sciences. This STP has promoted the installation of the following innovation hubs: 1) BioHub in cooperation with the Brain Institute – InsCer, Hospital São Lucas – HSL and the University Schools. 2) +Healthplus, a health cluster that runs digitally and face-to-face, led by Tecnopuc and Grow+. 3) NAVI, an Artificial Intelligence and Data Science hub led by Tecnopuc and Wisidea Ventures, an accelerator for technology-based companies. 4) Celeiro, an Agro Hub led by Tecnopuc, Anlab and Ventiur Acceleradora to connect producers, suppliers, cooperatives, startups, researchers, and investors in the agribusiness sector. 5) Farol, a Social Hub, which connects the University's innovation, entrepreneurship ecosystem and companies, civil society organizations and public authorities to act collaboratively to foster social development. 6) Cumbuca, a Food Hub, led by Tecnopuc, connects people, organizations, and disruptive food startups to generate opportunities for

entrepreneurship, innovation and impact through science and technology. 7) Hub EduX a hub to develop innovative solutions in the education sector connecting them with the market.

From Tecnopuc experience in Brazil, their vision is to be a key factor in the ecosystem of innovation, and a vector of transformation for the University and the society. The consensus system vision 2030 is to be recognized as a global environment for innovative business generating sustainable solutions for the university, society, and organizations. The strategic intention is to create one thousand new business initiatives in a ten-year period. They are also moving to be part of an innovation area in the Porto Alegre City which has been said in a recent alliance for innovation, called “Pacto Alegre”, signed by three universities, local government, and industry.

To achieve this goal Tecnopuc proposed a new innovative organizational model with seven nodes:

1. Orchestration; that’s responsible for the governance, conducting the network under an institutional and political perspective. This node includes the legal and communication offices.
2. Tecnopuc Startups: This node oversees developing on innovative ventures and startups.
3. Tecnopuc Crialab: Responsible for training projects and services involving methodologies of creativity, design, and innovation.
4. Project Management: Responsible for the management of new projects and the analysis of demands arising from financial operations associated.
5. Social impact: Responsible for the development of entrepreneurial actors, aiming to find opportunities to develop a culture of social impact.
6. New Business and Negotiation: Responsible for prospecting and commercializing the portfolio of products and services offered by the ecosystem to society and to the University.
7. Infrastructure Management: Responsible for the management of ecosystem support services, including the monitoring of the university units and third parties contracted services.

The Program on Support to Technology Hubs has currently twenty-seven hubs. These consist of institutions that work together increasing the regional development and were established according to the criteria of the Regional Development Councils (Coredes). It was an effort that involves human resources, laboratories and equipment from universities, private companies or public bodies and associations, targeted to the creation of processes, products, or services. In each of the hubs there is at least one university responsible for the execution of the research projects consistent with the local productive vocations.

Technology-based incubators are responsible for integrating scientific research, technology transfer and development of new products. The Rio Grande do Sul Incubators program supports this activity. New incubators can apply for the program support at any time granted access for funding launched yearly.

As for the Rio Grande do Sul’s Program of Technology Parks, it aims to contribute to the expansion of investments in scientific and technological research, technological development, and incorporation of new technologies, by increasing the competitiveness of the State’s economy. These tools will stimulate the generation of business, work, and income. This network, currently formed by twelve parks registered at the program, induces the creation of local companies and the attraction of investments to Rio Grande do Sul.

Summary of Suwipa Wanasathop presentation

In Thailand, direct foreign investment is encouraged in areas intensive in knowledge and innovation, this economy seeks to be a hub in Asia and aims to promote links with Japan, Korea, and China economies. Also, from China where having achieved the internalization of their STP, are planning to go on in new expanding processes promoting links and new business with Europe and America. Networking is a strategic part in most STPs, but it is also in universities, outside of them, between regions and between companies.

The importance of the government support is highlighted in all the economies and mentioned as a key action for the development of innovation ecosystems. The more mature the economy is, the more diverse and differentiated public support instruments availability to target organizations at any development stage. These public interventions in supporting and promoting the STP also responds to the attributed significant role and potential of this organizations in the achievement of the Sustainable Development Goals defined by the United Nations (SDG 2030). That is mean the need of promoting social and environmental sustainability in addition to the economic and market focus. The tools for achieving these goals are not generic because of regional different capacities and opportunities. In many cases prioritized actions could be focused on renewable energies, and others in circular economy but in any case, a top-down vision is needed to be shared by all the actors in territory.

Startup Thailand 2016, a government-organized event, for raising awareness of tech startups and bringing the sector together. In 2016, the Thailand Ministry of Information and Communication Technology was reformed and renamed the Ministry of Digital Economy and Society (MDES). That same year, the National Startup Committee (NSC) was set up to find ways to improve the ecosystem. The Software Industry Promotion Agency was also established and supported startups with coworking space and digital infrastructure. In 2017, the Digital Economy Promotion Agency was created under the MDES. The main sectors where startups are receiving incentives for international immersion are Fintech, E-Commerce, Business Solutions, Blockchain and Edtech.

Other relevant sectors are the Agritech that can help increase the productivity of farmers, who are among the poorest in society and Cleantech or Greentech which offers solutions to improve environmental sustainability and mitigate climate change.

Intellectual property should be another central aspect in open innovation processes. STPs also can be important platforms aiding in strategies to protect inventions, intelligence surveillance and another related services for entrepreneurs in the regional ecosystem. The STPs could allow to accelerate development through contributions in the creation of intelligence networks between the APEC economies to help all the actors. When betting on disruptive technologies, the role of knowledge protection instruments is more relevant in business creation. In less developed economies, although not having the same relevance these instruments could be used in technological adaptation, bringing licensed solutions to local problems solving in any fields.

Inventions and innovations are in many economies the cornerstones of successful competitive products and business reforms. The innovative ideas may come from the needs of markets from customers, or from university research among other actors but not all of them are ready to become marketable products. There is an ideation and development phase, in which several projects should be under way simultaneously, because all of them will not be successful. After several phases, many inventions can be converted into finished products that are taken into production and marketed. The development phase requires plenty of creative effort, know-how and financial resources, for

which outside expertise is usually needed. First assistance in developing an idea into a product for business is often received from Innovation Centers and Start-up or spin-off companies begin their activities often in incubators, which often are in or are part of STP.

Cross-border open innovation increases competition and hence the pressure for excellence in research, development, and innovation. It holds the potential to accelerate innovative solutions to the problems facing modern economies and societies. It can make domestic innovation systems more efficient and can lead to increases in the return to investment in research and development. This in turn strengthens the incentives for such investments and leads to a higher R&D intensity and hence a higher knowledge intensity in the economy. In turn, this improves international competitiveness. Because open innovation involves different partners, and often partners from different economies, it brings its own challenges in the management of intellectual property.

In the "DNA" of the STP should be the development of knowledge, creativity, purpose, and intentionality to get out of the comfort zone and create a sustainable development from the social and environmental point of view. The accreditation of STPs and their certification under international quality standards is also perceived as a key factor to create intra- and inter-regional trust.

Summary of AXIS II Discussion panel:

Despite the differences in the STP allocations presented in the study cases and the particularities in socio-productive environments conditions, the speakers remarked many coincidences from their experiences. Both TECNOPUC and the Thailand STP agreed in promoting changes to accelerate the digitalization of SME, the changes in organizational models and put the human ware in the center of the transformations and new strategies to overcome the covid 19 impact in the economy and in their regions.

From the perspective of TECNOPUC CEO, the STPs are perceived as builders of local ecosystems, so within a regional development strategy they have promoted business participation and the strong development of startups from the academic sector. In a complementary way, TECNOPUC has restructured their organizational model looking to have a flatter pyramid, with few command levels, and working in flexible teams that are adaptable to changes in business or in the global economy. This vision in many aspects is complemented by the Thai experience which emphasized in the role of human resources as the protagonist of the change and adaptation processes. Additionally, both ecosystems are making a strong commitment to digitization, the need to promote virtual work and business environments among all agents. Open innovation, and internationalization platforms to connect local ecosystems with global ones were key factors in their strategic plans to support regional development.

Another important result found in the discussions is the consensus of the significant role played by business incubators within STPs. In this sense, both the Latin American experiences and those of the economies of Asia, North America and Europe showed their inclusion as protagonists in internal and regional change. The new startups are more knowledge-intensive and many of them have made important contributions by supplying products and services of great relevance to face the global health crisis generated by COVID 19.

Axis 3: Evolution of science and technology parks and their adaptation to the 4th Industrial Revolution.

Summary of Hebert Chen presentation.

TUS Holdings ("TUS") is the university-owned enterprise of Tsinghua University. As a holding corporation managing assets valued over US$30 Billion and a controlling shareholder/shareholder of over 800 enterprises, TUS has established the world's largest global innovations ecosystem with over 200 innovation bases that have incubated over 5000 enterprises. TUS developed a model integrating incubation services, financial investment, entrepreneurship training, open innovation, and an end-to-end financial service platform. It invests in and runs some of China's leading corporations in environmental protection, new energy, healthcare, new materials, and other strategic emerging industries. TUS has three main types of business platforms for enterprises: TusStar Incubators, TusParks, and TusCities. These are spread over 50 cities, such as Beijing, Shanghai, Shenzhen, Guangzhou, Suzhou, and more, making it China's biggest innovation ecosystem.

According to TUS Park experience, STP need to concentrate at how to supply the up to date and value-added service to the tenants in 4th IR. In the new environment conditions, it is the services which make the difference, and because of that, should be considered as key factors for improving regional competitivity. This vision leads to assign the best people in new services to succeed under the new paradigm change.

In summary, from their point of view the core function of the STPs is to create a reginal ecosystem conducive to the generation of great ideas, knowledge exchange and the growth of high-tech SMEs.

Tus Parks presentation put in evidence many changes in the demand of services from the STP due to the paradigm changes originated by the 4th industrial revolution and catalyzed by the Covid19 pandemic. Demand for free space and simple services changed, also the services for financial support, networking, and marketing. Other changes respond to the location of STP and the use their facilities. The new tendencies show new preferences for remote working or diversifying services and expanding the areas of influence. The STP are evolving to innovation areas or innovation districts. It is remarkable that key monitoring is a need to understanding the new real needs of customers and it is a good starting point of all work in the STPs.

From their experience in the new global scenario the Government has the role to states guidelines and policy making for the 4th Industrial Revolution. The industry is the engine for taking advantage of the new competitive advantages and prioritize networking to improving connections local and globally. Finally, the academic sector is also visualized like an important source of the innovation, and to direct research activities to problem solving. The financial support is another key factor to be considered in the toolbox for the development of small and medium enterprises to help targeting more sophisticated markets and improve trade. At the top of this pyramid is the society, the natural receptor of all these actions designed to achieve better living conditions as the final goal. Because of that, cultural and educational actions must be promoted as well as capacity building in health services. All the previous mentioned factors conform a long-term cooperation model of mutual benefit with resource suppliers instead of one-time use.

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In summary, from their point of view the core function of the STPs is to create a reginal ecosystem conducive to the generation of great ideas, knowledge exchange and the growth of high-tech SMEs. Therefore, the STPs can play its role in both developed and developing economies, and in the past, present, and future industrial revolution.

Summary of Marta Leal presentation

The Nuevo Leon STP is an instrument for promoting the Knowledge Economy and Society, which has among its long-term aims to increase GDP per capita in the economy. This outcome points to the transformation of the local industry sector by promoting the culture of innovation and entrepreneurship with high added value.

This STP, found in the municipality of Apodaca, Nuevo León, has 38 research centers and 2 high-tech business incubators. It is an active member of the international associations Association of University Research Parks (AURP) and International Association of Science Parks (IASP), which incorporate the most renowned scientific-technological parks in the world, which allows a continuous exchange of experiences for the consolidation of the park.

The Nuevo Leon, Mexico case showed their strategic actions and results in transferring knowledge to the productive sector. The governance of Nuevo Leon STP has a triple helix-based management mode, promoted from PIIT Monterrey. This institution resulted from an emblematic governmental project with an important initial investment. The STP is operative since 2007 and in 2020 had received USD 112 million from State Government, USD 196 million from Federal Government and USD 364 million from private sector.

Universities, public research and development centers and companies interact within an open innovation model to create value in strategic sectors prioritized by the STP and the regional development system.

The human capital and the technological infrastructure are the key factors for improving the capacity of generating high quality research and development projects and new technological companies. These activities support local development and the connectivity with global ecosystems and with the society seeking directives to become an instrument of sustainability by environment protection, and carbon print reduction.

The main strategy promoted from Nuevo Leon innovation ecosystem is to evolve from a triple helix model to a Penta helix one that includes the society and investors capital. In this model, the 2027 vision is to convert Nuevo Leon in a Smart State with more high-tech enterprises, digital society, smart agrotech labs, smart health labs, remote health, and education centers.

The core components of this innovation environment deal with education, technological infrastructure, the whole federal STI system, competitiveness, and entrepreneurship and with Government and society.

The educational subsystem emphasizes in preparing new researchers, technicians, workers, or any society members to face the new industry 4.0 challenges. The technological infrastructure helps and assist the educational centers by making available for them makerspace, fab-labs, and tech shops for industries 4.0 startups or companies supporting them in digital transformation.

Summary of AXIS III Discussion Panel

The focus group on the adaptation of STP to the new revolution of industries 4.0 was made up of the representatives of Parque de Nuevo León and Tus Park, Marta Leal and Herbert Chen. José Luis Alesana join them, from the Technical University of Munich, a doctoral student in bioinformatics with experience working in parks in Chinese Taipei; China and Singapore. In addition, Omar Florez, a machine learning specialist at Tweeter Cortex, takes part, among other topics, he was a researcher at Intel Labs, applied Deep learning and Machine learning, with numerous awards and recognitions. Pattravadee Abadie Ploykitikun, director of the STP of Thailand, doctorate from the University of Portland (USA), with experience in mechanical engineering, high tech, and project manager in regional clusters.

Some considerations made from the Asian economy are in line with the earlier exposed results and emphasize in that the core function of the STPs is to create a reginal ecosystem conducive to the generation of great ideas, knowledge exchange and the growth of high-tech SMEs. Therefore, the STPs play this role in both developed and developing economies, and in the past, present, and future industrial revolution. With adaptation of the 4IR, the development trend of the STPs includes: the physical boundaries of the STPs are becoming increasingly fuzzy, the service content is becoming more and more professional, the services are constantly updated and modernized following the development of science and technology, and the Governance/Management body is becoming more and more diversified. No matter how the service content and ways the STPs are updated and developed, paying attention to the needs of customers, integrating multiple resources, selecting proper locations and infrastructure, and providing services required by customers all are important core factors for the success.

STP are not closed entities, so they need to set out new strategies and a re-orient of their position and role in the urban and regional context. There is an emerging tendency in STP in making efforts to expand their boundaries in the territory promoting the creation of Areas of Innovation. These zones have its own specific management team, and their main goals include economic development through the promotion and attraction of selective innovative business for which specific services are provided.