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Strengthening science, technology and innovation parks in national innovation systems of developing countries

Technical note

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I. Introduction

Science, technology and innovation (STI) parks are essential components of robust innovation ecosystems. An innovation ecosystem is the evolving set of actors, activities and artefacts, as well as the institutions and relationships that work together to promote entrepreneurship, innovation and economic development (Granstrand and Holgersson, 2020; Sotirofski, 2024). Within an innovation ecosystem, STI parks act as intermediaries, bringing together the various actors and institutions, including government, industry, academic and research institutions, communities, entrepreneurs, financiers, entrepreneurship and innovation support structures such as incubators, and markets (Amoroso and Soriano, 2019; Hermann et al., 2020). Owing to their unique catalytic characteristics, STI parks function as a bridge between these various actors.

Typically, STI parks are physical spaces where multiple technology- or knowledge-intensive organizations co-locate. Their objective is to stimulate innovation based on research and development (R&D) and leverage STI capabilities (UNCTAD, 2015). The primary objective is to foster innovation through R&D activities, forge and strengthen cooperation among firms, facilitate knowledge transfer and promote the transfer of technology, not only from academic and R&D institutions but also from outside the region, to firms (Makhdoom et al., 2022). In various innovation ecosystems, STI parks may be known by different terms, such as innovation hubs, tech hubs, technopoles, research parks, science parks, or innovation clusters (United Nations Industrial Development Organization (UNIDO), 2021).

STI parks build bridges across innovation ecosystems

STI parks must be embedded in national innovation policy

What distinguishes STI parks from business parks is the co-location of multiple knowledge-intensive organizations, including research institutes, which enables them to leverage shared capabilities, knowledge and technologies within an enabling environment (Ng et al., 2020). They promote a culture of innovation and competitiveness among firms, academic institutions and research institutions; facilitate technology transfer to universities; strengthen networks between firms; and facilitate the identification of external knowledge sources (Hermann et al., 2020). The outcome of STI parks should catalyse a knowledge-based economy and contribute towards local and regional economic growth. In contrast, business parks do not have this as a primary focus.

Proximity to, or integration with, academic and R&D institutions is often cited as a hallmark of successful STI parks, as these institutions are central to research, innovation and knowledge generation (Sibanda, 2021). Firms located in or near STI parks benefit from improved access to talent and opportunities to enhance their innovation capacity (Makhdoom et al., 2022). The clustering of firms across different segments of the industry value chain promotes collaboration, facilitates knowledge transfer and reduces uncertainty, particularly for start-ups and young enterprises, when supported by effective incubators (Ng et al., 2020). Martínez-Cañas et al. (2011) argue that clustering within STI parks can mitigate constraints such as limited access to capital, technology, skills and markets. They emphasize the value of social capital generated through relationships among academic and R&D institutions, high-tech firms and STI park management, which collectively create a supportive environment for innovation.

Given the varying maturity levels of innovation ecosystems, some countries operate well-established STI parks, while others, particularly in the developing world, are in the early stages of establishing or exploring such models. The transformative potential of STI parks is succinctly articulated by Lyken-Segosebe et al. (2020), who note that they "contribute to local, regional and national economic growth and development through diversification of the industrial base, job creation, entrepreneurship and skills development, revenue for sponsoring universities and broader social development".

For STI parks to succeed, they must be able to attract technology-based firms and related industries (Makhdoom et al., 2022). They should be recognized and designed as integrated innovation policy instruments, not developed in isolation (Organisation for Economic Co-operation and Development (OECD), 2021). In today's globalized and knowledge-intensive economy, STI parks can play a pivotal role in national innovation systems by developing and collaborating with relevant stakeholders to address market failures and stakeholder needs.

This technical note aims to provide policymakers, practitioners, and stakeholders with practical guidance to enhance the role of STI parks in innovation-led development in developing countries. Drawing on international experience, it synthesizes best practices and offers evidence-based policy recommendations tailored to diverse national contexts. When supported by appropriate interventions, STI parks can become powerful enablers of technology transfer, high-tech industry development, investment attraction and the transition to knowledge-based economies.

II. International practices and lessons learned

This section reviews selected international examples of integrating STI parks into national and regional innovation systems. These cases demonstrate diverse models of success and offer valuable lessons for adaptation in developing countries.

Many of the most successful STI parks are in developed economies, such as the United States of America, Europe and, more recently, China. Countries such as Spain and the United Kingdom of Great Britain and Northern Ireland have long-standing traditions of prominent science parks. For example, since its establishment in 1992, Malaga TechPark has become an integral part of the city of Malaga and a cornerstone of its economy.[1] Hosting 72 foreign firms from 22 countries and over 687 companies in total, the park employs more than 25,000 people and has contributed to the growth of sectors including electronics, IT, telecommunications, computing, artificial intelligence, cybersecurity and renewable energy.[2] Through affiliations with global networks, Malaga TechPark enables firm internationalization and facilitates knowledge and technology exchange. Its close relationship with the University of Malaga and other academic and research institutions further enhances its capacity.[3] The park contributes significantly to the regional economy, GDP and employment at 1.65 per cent of the region of Andalusia and 8 per cent of Malaga province.[4] Local and regional governments have played an active role in its activities from its inception in the 1990s, recognizing its importance in positioning the region as a technology hub. This has significantly contributed to its success and ability to engage with industry and universities.

Utrecht Science Park, the largest in the Kingdom of the Netherlands, spans 300 hectares and is home to Utrecht University and the UMC Utrecht hospital.[5] The park supports clusters in agri-food, chemistry, energy, regenerative medicine, oncology, life sciences and biotechnology. It provides laboratories, offices, incubators and R&D centres, housing 85 campus-based

1 https://www.kadans.com/science-clusters/malaga-techpark-malaga.
2 https://www.bhhsspain.com/en/blog/technology-park-malaga-expansion-records.
3 https://www.callumswanrealty.com/2173-malaga-technology-park-burgeoning-new-tech-centre.html.
4 https://www.pta.es/en/.
5 https://www.kadans.com/science-clusters/utrecht-science-park-utrecht.

companies, 22,000 employees and 50,000 students. Joint projects with the city and province of Utrecht reflect its integration with public and academic institutions. The park promotes knowledge-based employment and is expanding through satellite science parks in nearby towns.

University links drive STI park success stories

Cambridge Science Park,[6] Europe's oldest and among its most successful STI parks, hosts over 170 companies employing more than 7,000 people. Many of its firms are university spin-offs and maintain active research partnerships with the University of Cambridge.[7] Located on 152 acres, the park includes laboratories, offices, conference spaces, restaurants and professional service providers, including venture capital firms. Its sectoral focus includes biotech, life sciences, biomedical, pharmaceuticals, green technology, chemicals, software, data science and artificial intelligence. The science park has played a pivotal role in transforming Cambridge from a university town into one of the world's leading technology hubs in the biotech and life sciences sectors.[8] This is enabled by the hospitals, two universities (the University of Cambridge and Anglia Ruskin University) and a thriving start-up and inventors' community.[9] Embedded in the United Kingdom innovation system, the location of the universities has played a significant role in the success of the Cambridge Science Park and this has been at the fore of the growth of a "substantial cluster of highly innovative technology firms in the Cambridge region" (Keeble, 2001).

Z-Park blends research, business and global outreach

STI parks have been an integral component of China's national innovation ecosystem, with particular emphasis on internationalization (Malta-Kira et al., 2025). Zhongguancun Science Park (Z-Park) in Beijing, established as the country's first national high-tech and innovation demonstration zone, is a leading example. Covering 13.5 hectares of land, it is China's first national high-tech and national innovation demonstration zone.[10] Specializing in information and communication technology, biomedicine, smart manufacturing, modern transportation, energy, and new materials, it is home to over 90 academic institutions and more than 400 research institutes, as well as over 50 leading industries and tech companies, including Tencent, Lenovo, Baidu and Xiaomi. Z-Park supports R&D, commercialization, incubation, technology transfer and international cooperation. It also assists other countries in establishing STI parks and has liaison offices abroad to attract foreign investment.

Japan's Kanagawa Science Park, established in 1984 on 55 hectares, is home to 117 companies employing 3,700 people.[11] The park benefits from proximity to major academic institutions and hosts the R&D units of large technology companies. It is well networked with other STI parks in Japan and around the world. Although initially established through collaboration between industry, academia and government (Kawasaki City Government and Kanagawa Prefectural Government), the park is privately owned and operated by five companies. There is close collaboration with the Kanagawa Academy of Science and Technology, which contributes to an enabling innovation ecosystem (Economic and Social Commission for Asia and the Pacific (ESCAP), 2019). The academy supports R&D activities, assists with patent and related intellectual property processes

6 https://www.cambridgesciencepark.co.uk.
7 https://www.ukspa.org.uk/cambridge-science-park.
8 South Cambridgeshire District Council. The evolution of Cambridge science parks. Available at https://www.scambssc.com/articles/the-evolution-of-cambridge-science-parks.
9 University of Cambridge Enterprise. Cambridge reveals innovation blueprint to become world's leading science and tech region. Available at https://www.enterprise.cam.ac.uk/news/cambridge-reveals-innovation-blueprint-to-become-worlds-leading-science-and-tech-region/.
10 National Center for Science & Technology Innovation. Science parks in Beijing. Available at https://en.ncsti.gov.cn/watchThis/parks/#:~:text=Zhongguancun%20Science%20Park%20located%20in,first%20national%20innovation%20demonstration%20zone.
11 https://www.ksp.or.jp/en.

and shapes local R&D programmes. The park's management team operates an incubator and provides support services to growth-stage companies. Several factors contribute to the park's success. These include its strategic location near Tokyo, its access to R&D-intensive universities, the strength of its incubation programme, and the active involvement of local government in building networks and linkages. Local authorities have played a significant role in funding infrastructure and adopting policies that are both directive and supportive of park activity and development. Governments have incorporated local actors into the park's ecosystem and kept the public informed about activities, updates and developments. The presence of top-tier tech companies and R&D facilities, combined with strong policy support, has played a critical role in the success of the incubation programme (ESCAP, 2019).

Many of the aforementioned STI parks have been enabled by policies that encourage R&D investment and "effective mechanisms for technology and knowledge transfer, enabling the expedient transition of innovative developments from university research laboratories to business production facilities" (Hrebennyk et al., 2024). As such, many successful parks are located in close proximity to research-intensive universities and a critical mass of technology-intensive companies.

Government plays a critical role in the success of science parks, as many examples show, including The Innovation Hub (South Africa), Botswana Digital and Innovation Hub (BDIH), Daedeok (Republic of Korea), Puspiptek (Indonesia) and Skolkovo (Russian Federation), where governments have provided significant financing for infrastructure, buildings and strategic local industrial policies supportive of the parks' activities, as well as establishing an enabling environment conducive for R&D collaboration and innovation (ESCAP, 2019). These policies include tax incentives and the strategic clustering of R&D and tech activities.

In the cases of BDIH and The Innovation Hub, the Governments of Botswana and the Province of Gauteng, respectively, have fully funded infrastructure development and continue funding operational costs, including for personnel. They have positioned these parks as central actors in the implementation of national and regional innovation strategies (Sibanda, 2021). BDIH has been designated as a special economic zone, a policy instrument used for fostering economic development. The Government of the Republic of Korea, for example, designated Daedeok as a special R&D zone and innovation cluster, thereby integrating the park into the regional and national innovation ecosystem. This integration enables the government to direct specific investments and activities into the park. Today, Daedeok hosts 26 government research institutes, 7 universities and over 1,669 firms (ESCAP, 2019). Another success factor identified in all the successful parks has been the quality and depth of the management team, which should possess a diverse set of skills and the ability to adapt to an ever-changing environment. The team should also have expertise in R&D, as well as business, marketing, negotiation and communication skills (ESCAP, 2019). This is evident if one considers the management teams of the cases so far discussed.

The experiences outlined in the preceding paragraphs underscore the importance of a supportive policy environment, investment in human and physical infrastructure and proactive engagement with academic and industry partners as preconditions for effective STI park development. In all of these successful case studies, governments have employed various policy instruments to support STI parks, including infrastructure financing, R&D incentives, direct funding and enabling regulatory environments, particularly in the case of special economic zones. The STI parks have become an integral part of the innovation ecosystem, playing their role as intermediaries, facilitating engagement, or serving as a focal point for different actors.

Policy support is vital to STI park success

III. Challenges in developing countries

Despite the promising examples given in chapter II, many developing countries face specific barriers that require targeted interventions and long-term commitment.

Embedding STI parks in policy unlocks their full potential

Despite some early isolated pockets of excellence in STI parks within developing economies, these parks face several persistent challenges. Primarily, these instruments are not embedded in the national or regional innovation policies and ecosystems. This disconnect limits their strategic integration and diminishes their potential as effective intermediaries and enablers of innovation. In most cases, they are seen as real estate developments. In some instances, STI parks have been established without a proper understanding of the purpose of such parks and their distinct differences from other support structures, such as incubators or R&D institutions. In many countries, there is a lack of coordination in innovation ecosystems, resulting in minimal to no collaboration among various actors, including academic and research institutions, businesses, governments, financiers and entrepreneurs (UNCTAD, 2024).

Given the significant financing often required to establish and operate STI parks, many governments either do not allocate sufficient funding or assume that the STI parks will be self-sufficient within a short period, which is rarely achievable (UNCTAD, 2024, 2025).

Accordingly, despite funding the initial infrastructure, financing is not forthcoming to develop the necessary bulk infrastructure (provision of water, sewerage and electricity services) required to enable the private sector to locate in the park. Examples include Maluana Science Park (UNCTAD, 2024) and The Innovation Hub (Sibanda, 2021), among others. As already highlighted by experiences in best international practices, in terms of success, a diverse and experienced management team is critical for the effective operation of STI parks and for gaining the confidence of the private sector and investors. This requires consistent and adequate public funding for staffing and expertise, as well as minimal, if any, political interference in the appointment of the management team.

In addition to funding for the establishment of critical infrastructure, several systemic challenges in establishing and operating STI parks in developing countries have been identified in recent UNCTAD studies (2024, 2025), including:

(a) Low R&D intensity and insufficient R&D outputs that can be commercialized;

(b) Underdeveloped STI sector and lack of supportive conditions for STI development, reflected in low scores for innovation capability and STI adoption;

(c) Insufficient synergies between universities and industries;

(d) Poor linkages with the private sector;

(e) Poor coordination among various actors involved in STI, even among different government ministries;

(f) Limited public awareness of STI parks as development instruments among actors in the innovation ecosystem;

(g) Insufficient infrastructure and support mechanisms to respond to the growing interest in STI parks;

(h) Lack of a robust public–private partnership framework to allow the private sector to collaborate with the government in establishing and operating STI parks;

(i) Lack of critical management resources and expertise to effectively nurture innovation and entrepreneurship.

IV. Policy recommendations

To address the various challenges faced in establishing and operating STI parks and ensuring that they are embedded within regional and national innovation ecosystems, governments in developing countries need to formulate and implement the necessary policies, regulations and infrastructure to support STI parks as integral components of their innovation ecosystems.

The measures outlined below may serve as a guiding framework:

A. Integrate STI parks into innovation policy to enhance collaborative networks

STI parks can anchor collaborative innovation across sectors

- **Promote sustained university–industry collaboration:** According to UNCTAD (2015), "STI parks are probably among the most widely used instruments to promote collaboration in STI". Greater engagement between STI parks and stakeholders (universities, research institutions, industry, government) is critical in ensuring that STI parks play a catalytic role as intermediaries within the innovation ecosystem, facilitating collaboration, knowledge spillovers and technology transfer, as has been seen with the examples provided in chapter II of the present note. Governments could consider giving tax incentives to support the establishment and operation of STI parks, as well as R&D either undertaken within the parks, or by established local or international companies and universities in collaboration with companies located in the STI parks (ESCAP, 2019).
- **Encourage cross-sector projects:** In rolling out collaborative R&D and innovation programmes, governments

could use STI parks as coordinators of collaborative projects, leveraging their intermediary role and ability to bring different parties together. This can extend to STI parks acting as open innovation champions on behalf of government and industry, helping to identify solutions to service delivery challenges and industry challenges, as is the case with The Innovation Hub (Sibanda, 2021). STI parks can be positioned by governments to play a critical role in developing targeted strategic industries, as is the case with Daedeok in the Republic of Korea, which has facilitated collaboration on joint commercialization projects between universities, research institutions and companies in targeted industries (ESCAP, 2019). In this regard, in addition to making funding available for projects in targeted industries, establishing special committees that include industry partners, together with other actors in the innovation ecosystem, would help better position the STI parks.

- **Implement shared facilities and resources:** National direct financial support or indirectly through tax incentives are essential for the success of STI parks as long as they are part of a national or regional STI policy and R&D. The successes of many Asian parks such as the Z-Park and Kanagawa have been due in part to the governments' strategic intervention to locate critical R&D facilities within the parks, thus creating R&D centres of excellence. Strategically placing critical STI infrastructure at STI parks, for shared access by stakeholders, can extend to networking and event spaces. This ensures that STI parks are best placed to host STI events, thereby creating an innovation community and an enabling environment for collaboration. This can also include incubation and pilot facilities, shared offices, open and other collaborative spaces, high-speed connectivity and support for start-ups (ESCAP, 2019).
- **Position STI parks as innovation and industrial policy implementing agencies**: Align STI parks' mandates and strategies with national and regional development priorities. As part of the development of a knowledge-based economy, ensure the differentiation and specialization of STI parks, including being at the core of smart-city policies and strategies, as well as the development of innovation districts. In this regard, it is imperative that government policies are directed at developing a robust technological base that ensures the STI park remains relevant and attracts technology-based companies that contribute meaningfully to high-quality employment (Van Dinteren, 2021).

Shared spaces spark innovation and strengthen collaboration

B. Increase awareness and visibility of STI parks

- **Showcase success stories and economic impact:** Often, there is no shared common purpose for STI parks. Governments can enhance public understanding of the important role of STI parks in innovation ecosystems by ensuring that marketing and communications strategies are in place to showcase STI parks and stakeholders' activities, as well as their contributions to national and regional priorities. This could include newsletters, impact reports, open days, media coverage and social media content, with a particular focus on the problems solved and the impact achieved. It is critical that policy attention is given to the design and management of science parks, as they are more than infrastructure or real estate initiatives, recognizing their role in facilitating proximity, collaboration and innovation, and in contributing to developmental goals (Ng et al., 2020).
- **Engage in regional and national innovation initiatives:** For STI parks to play a critical role in innovation ecosystems, it is imperative that

appropriately qualified management teams are appointed and empowered to participate in national and regional STI dialogues and events, to increase awareness among stakeholders of the important role played by STI parks.

- **Participate in global science park networks:** With the ever-changing role of STI parks in the global economic and technological environment, membership and active participation in global associations and networks, such as the International Association of Science Parks, will ensure that STI parks stay up to date with global best practices and find ways to contextualize these in local settings. Being part of these networks will position the STI parks as channels for global market access by their residents and start-up companies. In addition, a network of STI park experts is being formed through the UNCTAD project Science, Technology and Innovation Parks for Sustainable Development: Building expertise in policy and practice in selected Asian and African countries, which was financed by the 2030 Agenda for Sustainable Development Sub-Fund under the United Nations Peace and Development Trust Fund. This network will bring together experts from different continents, notably those that have participated in the activities under the UNCTAD project, to exchange knowledge and practices tailored to the needs of developing countries.

Global networks strengthen local innovation capacity

C. Ensure governance, management and operational coherence

- **Governance and management:** Ensure that appropriately constituted governance models are in place, comprising not only government-appointed members but also broader representation from stakeholders within the wider ecosystem. Successful STI parks comprise a diverse, dynamic and business-focused professional management team that is well networked in the innovation ecosystem and can build and manage relationships with various stakeholders. As a collective, the team should possess expertise and experience in R&D and innovation management, coordination and communication, capital management, infrastructure development, facilities management, business, marketing, entrepreneurship, incubation, new venture creation and growth, negotiation, events management, networking and communications, and be adaptable (UNIDO, 2021; UNCTAD, 2024; Wang, 2019).
- **Streamlined bureaucratic processes:** Ensure that the operations of STI parks are seamless and that decisions can be made quickly, whether for new tenants, funding or other support that STI parks provide. STI parks should themselves be innovative in their operations and engagement within the innovation ecosystem.

D. Make STI parks relevant to the surrounding economy

- **Tailored capacity-building:** Establish and implement comprehensive, context-specific incubation and acceleration programmes that are in support of spin-off or start-up programmes at academic and research institutions from the surrounding regions.
- **Align activities of STI parks with local industry:** Support STI park tenants and partners in responding to industrial demand through targeted upskilling efforts, such as mentoring, technical training and access to professional networks to support firm-level innovation and job creation, thereby increasing the relevance of STI parks to the economy.

V. Conclusion

STI parks are strategic assets for countries seeking to diversify their economies, boost innovation and foster inclusive growth.

STI parks, when integrated within innovation and industrial policies, have a great potential to contribute to national and regional development goals. The integration must be deliberate, through the use of policy instruments such as incentives, financing of infrastructure development, ensuring an appropriately qualified and diverse management team, tasking the STI park to coordinate activities relating to the development of strategic industries and collaborative research initiatives, and boosting R&D investment to increase knowledge that can be transferred to industry.

When integrated within innovation and industrial policies, STI parks have significant potential to contribute to national and regional development goals.

Governments need to ensure that there is sufficient investment in establishing the base infrastructure required to attract private investment and partners. The investment should extend to programmatic interventions that support innovation policies and foster collaboration.

Increasing awareness of STI parks and their role in the innovation ecosystem also demands that STI parks be managed by a well-networked, experienced and competent management team with broad expertise in innovation management. Innovation thrives in an ecosystem that nurtures a culture of entrepreneurship. STI parks should offer effective and accessible incubation and business growth programmes, supported by an entrepreneurial management team.

STI parks are catalysts for inclusive, innovation-driven growth

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