European Commission

JRC SCIENCE FOR POLICY REPORT

Exploring the Concept of Geographies of Innovation

Case studies from Amsterdam, Barcelona, Melbourne, and Stockholm

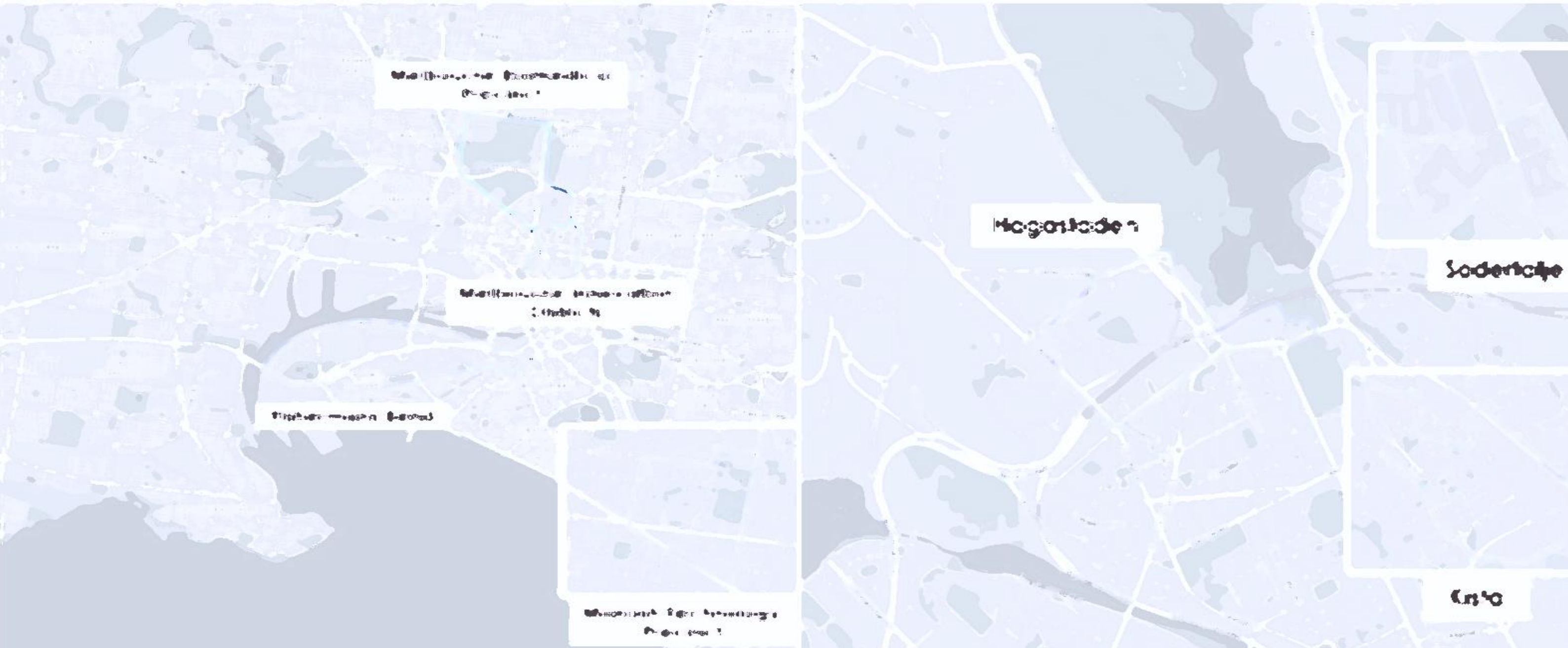
Victoria Galán-Muros

Fatime Barbara Hegyi

Alep Blancas

Andrea Sagredo

2021



EUR 30871 EN

Joint Research Centre

EU Science Hub
https://ec.europa.eu/jrc

JRC125482

EUR 30871 EN

PDF	ISBN 978-92-76-42639-4	ISSN 1831-9424	doi:10.2760/268816

Luxembourg: Publications Office of the European Union, 2021

How to cite this report: Victoria Galan-Muros, Fatime Barbara Hegyi, Alep Blancas and Andrea Sagredo. Exploring the Concept of Geographies of Innovation. Case Studies from Amsterdam, Barcelona, Melbourne and Stockholm, EUR 30871 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-42639-4, doi:10.2760/268816, JRC125482.

Contents

Abstract

In the last decades, so-called geographies of innovation have emerged worldwide as vehicles to drive economic development. These urban areas are planned and actively managed spatial clustering of a wide range of innovative organisations and intermediaries to undertake collaborative innovation activities. However, the concept of geography of innovation (or innovation geography) remains ambiguous. In addition, there are no commonly accepted definitions or classifications of different models of geographies of innovation. Terms such as park, hub, district, cluster, and ecosystem are used interchangeably, and their definitions can be far-reaching and adaptable. The key question addressed in this research is the main challenges of current policies for geographies of innovation in Europe, offering a view on how governments can better support the emergence and development of geographies of innovation in Europe.

Hence, this report aims to explore the concept of geographies of innovation as an evolution of industrial and business clustering combining theoretical and practical approaches. The authors propose a definition and classification of the different models of geographies of innovation, highlighting some of the main challenges in implementing this identification and measurement. The comparative case study analysis containing thirteen case studies from four cities provide evidence supporting the development of European, national, or regional policies, enabling current and future geographies of innovation to enhance their performance and their contributions to greener, cleaner, socially more just, and overall to more developed cities and regions in Europe and beyond.

Authors

Victoria Galan-Muros, Innovative Futures Institute, Granada, Spain

Fatime Barbara Hegyi, Joint Research Centre, Seville, Spain

Alep Blancas, Innovative Futures Institute, Granada, Spain

Andrea Sagredo, Innovative Futures Institute, Granada, Spain

Executive summary

Geographies of innovation entail planned and actively managed spatial clustering of a wide range of innovative organisations and intermediaries to undertake collaborative innovation activities. They can take the form of science parks, technology parks, and, more recently, innovation districts. Geographies of innovation can be essential for social and economic development. However, in general terms, Europe faces policy problems related to the inadequacy of specific policies to directly support such urban areas of innovation. There is insufficient horizontal and vertical coordination of existing policies and a lack of an integrative policy approach, among others. Therefore, some geographies of innovation encounter difficulties or even fail to develop.

The aims of this publication are manifold. First, it seeks to review the current fragmented and heterogeneous policy approach to geographies of innovation in Europe, highlighting the main challenges. Second, it sets out the holistic and integrative approach needed to successfully support the emergence and development of geographies of innovation and consider a wide range of policies in other areas that also affect these geographies. Hence, the paper explores the concept of geographies of innovation as an evolution of industrial and business clustering, combining theoretical and practical approaches. The purpose of this report is also to define and classify the different models of geographies of innovation, highlighting some of the main challenges in implementing the proposed identification, classification, and measurement. Comparative case study analysis includes a set of thirteen case studies from four cities. These cases provide evidence supporting the development of future European, national, or regional policies, enabling current and future geographies of innovation. Such policies are aimed to enhance the performance and the contributions of geographies of innovation to greener, cleaner, socially juster, and overall to more developed cities and regions in Europe and beyond.

This work builds on research by the Joint Research Centre and other European institutions, examining place-based innovation ecosystems to contribute to evidence-based policy development and local economic development overall. Several case studies have been produced to understand better the critical success factors and the nature of interconnectedness of actors in areas with a high concentration of innovation, including science parks and innovation districts. Amoroso et al. have explored concrete ways to systematically collect information on public and private organisations related to the support of science and technology parks by collecting evidence on such parks' impact on regional development (Amoroso et al., 2019). Rissola et al. (2019) has focused on the Boston area and argue that innovation districts may act as enablers for place-based innovation by implementing various place-grounded initiatives. In another publication, Rissola and Haberleithner (2020) provide a comparative analysis of policy development linked to urban innovation ecosystems through five European case studies. Lund et al. (2020) examine how to apply public-private partnerships as credible models for the development and operation of public infrastructures to the development of – among others – innovation districts, and their future work aims to support the creation and operation of innovation districts as engines of urban transformation and sustainable and inclusive growth. Hegyi et al. (2021) provide a set of methods and findings that heavily build on recent advances in using large-scale datasets and data science to understand the critical driving indicators of deprivation and success of various entities, such as urban areas with a high concentration of innovation activities.

Policy context. Europe presents a rather heterogeneous policy scenario for geographies of innovation. Although not all countries have policies that specifically target the emergence or development of geographies of innovation, relevant policy initiatives have emerged in most countries during the last two decades. Some European governments have expressed their political commitment by designing and implementing a set of policies to help create or strengthen geographies of innovation. These initiatives have been made at different governments levels and with varying degrees of success. There are still several challenges that many European countries face in their approach and efforts to support geographies of innovation.

Geographies of innovation tend to create employment quickly, and the jobs tend to be of high added value, increasing wealth creation. However, not all policymakers realise and exploit the potential of these geographies to reach development objectives. A reason why some governments do not commit enough resources can be precisely a lack of understanding of the long-term benefits that these geographies can provide. However, some national governments, particularly in less developed countries, might be reluctant to commit public resources to these geographies due to their limited budgets or more urgent competing priorities.

Policy recommendations. The success of geographies of innovation has been varied, and it is not always clear why some geographies of innovation do not reach their full potential or fail to develop. The existence and the types of policies, and the policy approach applied in specific geography can have a crucial influence on its emergence and development. Even as policymakers in European countries and regions will need to take different actions, this document reviews essential general recommendations that apply to all of them.

A series of specific policies are needed to support the geographies of innovation directly. However, new policies should distance themselves from traditional industrial policies and break the 'policy-silo pattern' by tackling the entire system simultaneously instead of specific components individually. This means that policymakers should support the management organisation of these geographies to facilitate their coordination and networking efforts, including developing skills for geography managers. Policies should promote networking among the organisations within a geography, which is essential to create relationships in which collaboration opportunities are explored, leading to longer-term undertake collaborative actions resulting in innovation. This publication, therefore, proposes a list of policy options for governments to support geographies of innovation.

1. Geographies of innovation, as keys for social and economic development

Geographies of innovation can be essential for social and economic development. Still, in general terms, Europe faces policy problems related to the inadequacy of specific policies to support geographies of innovation directly, insufficient horizontal and vertical coordination of the existing policies and lack of an integrative policy approach. This, in turn, limits the development or success of some geographies of innovation.

Geographies of innovation are planned and actively managed spatial clustering of a wide range of innovative organisations and intermediaries to undertake collaborative innovation activities (see section 2.2). Often representatives of the quadruple helix (government, academia, business, and society) interact within these geographies. ´Helices´ have evolved from isolated to more collaborative actors, from unidirectional to bidirectional exchanges and bilateral to multilateral relationships.

Higher education institutions traditionally described as isolated ´ivory towers´ are today the main human capital and knowledge providers of their regions involved in knowledge and technology exchanges with other actors and in entrepreneurial activities. The industry is progressively a recipient and a producer of knowledge and technology and collaborates with higher education institutions in education and research and with governments through public-private partnerships. The role of the government has evolved from regulator and controller to facilitator and active player, even showing entrepreneurial behaviour (Mazzucato, 2013).

Due to the close relationships of these organisations, knowledge and technology flows and synergies are created. This increases the alignment of the university curricula with the regional needs, graduate employability, skills of academics, scientific outputs, application and commercialisation of research, knowledge-based entrepreneurial activity, the emergence and growth of innovative and technology-based firms, patents, and licences but also open innovation exchanges (Davey, Plewa and Galán-Muros, 2014).

Geographies of innovation can provide a wide range of social and economic benefits not only for their tenants potentially but also for their communities (Kuzior and Kuzior, 2020). These benefits are in terms of networks; access to IP, talent, and infrastructure; job, upskilling and reskilling opportunities; income; upward social mobility and cohesion; talent attraction and retention; urban development and attractiveness; innovation capacity; productivity; competitiveness; economic activation, welfare, sophistication, and complexity; among others (Davey, Plewa and Galán-Muros, 2014).

Compared to non-innovation neighbourhoods, geographies of innovation produce on average four times higher intensity of tangible innovations per employee and nine times higher density of job opportunities. Furthermore, for every innovation-focused job the geography creates, it generates four or five additional support jobs. An inverse correlation exists between the concentration of innovation activities within a territory and a community's unemployment level (Burke and Grass, 2019).

In the ongoing uncertain times, with simultaneous public health, economic, social, and environmental crises, geographies of innovation represent an opportunity to share knowledge, innovate collaboratively, create shared value and eventually build back better. With three out of four Europeans living in cities, geographies of innovation can be the foundation of knowledge and technology-based economies, societies, and cities by combining top-down policies, bottom-up grassroots initiatives and horizontal peer learning and cooperation (Yun and Liu, 2019). This will lead to greener, cleaner, and more sustainable futures.

Despite the potential impact on the urban social and economic environment, not all policymakers realise and exploit the potential of these geographies to reach development objectives. A lack of understanding of the long-term benefits these geographies can provide might be why some governments do not commit enough resources. However, some national governments, particularly less developed countries, might be reluctant to commit public resources to these geographies due to their limited budgets or more urgent competing priorities (Ribeiro et al., 2016). Even in the context of a lack of direct investment, most European governments still support geographies of innovation more indirectly, e.g., through import and export duties relief. Thus, the objective of our study is to support decision-makers and urban planners to make better policy decisions linked to shaping and growing their innovation communities.

In addition to policy challenges, it is unclear if policymakers have paid sufficient attention to the influence that other policies can have in geographies of innovation. Whether these are educational, scientific, industrial, trade, fiscal, migration, different social or macroeconomic policies, they have rarely been considered in or adapted for the design and development of geographies of innovation. In some countries, national regulatory policies do not help but can substantially weaken some of these geographies. This can be the case of countries with very restrictive immigration policies, unfavourable trade policies, education policies that prevent excellence, lack of public support for the scientific community or very traditional industrial policies that support fossil fuels to the detriments of cleaner energy sources.

By exploring the concept of geographies of innovation as an evolution of industrial and business clustering, the publication develops a definition and classification for geographies of innovation to support integrative policy approaches towards these geographies.

First, it seeks to review the current fragmented and heterogeneous policy approach to geographies of innovation in Europe, highlighting its main challenges. Second, it sets out the holistic and integrative approach needed to support the emergence and development of geographies of innovation successfully and consider a wide range of policies in other areas that also affect these geographies. This report also aims to define and classify the different models of geographies of innovation, highlighting some of the main challenges in implementing this identification, classification, and measurement. Comparative case study analysis includes a set of six case studies of geographies of innovation from two cities.

These provide evidence supporting the development of future European, national, or regional policies in Europe, enabling current and future geographies of innovation to enhance their performance and contributions to greener, cleaner, more social, and more developed cities and regions in Europe beyond. This analysis is done so to be able to provide a holistic and integrative approach needed to successfully support the emergence and development of geographies of innovation as well as the consideration of a wide range of policies in other areas that also affect these geographies.

1.1. Policy context

This section offers a review of the current fragmented and heterogenous policy approach to geographies of innovation in Europe, highlighting its main challenges.

Europe presents a rather heterogeneous **policy scenario** for geographies of innovation. Although not all countries have policies that specifically target the emergence or development of geographies of innovation, policy initiatives have emerged in most countries during the last two decades. Some European governments have expressed their political commitment by designing and implementing a set of policies to help create or strengthen geographies of innovation. These initiatives have been created at different governments levels and with varying degrees of success. There are still several challenges that many European countries face in their approach and efforts to support geographies of innovation.

The first challenge is to decide who is the most **appropriate government body or agency responsible** for the design and implement the policies for geographies of innovation. These geographies lay in the intersection of a wide variety of areas whose policies have traditionally been separated. There is a robust urban aspect in these geographies regarding land development, use or ownership, and a regional development component. At the same time, different policies target the varied organisations within these geographies separately. For example, higher education institutions are regulated by education policies in their teaching and learning mission and science policies for the research mission. Science policies, together with technology and innovation policies, also regulate research institutions. In addition, businesses are mostly affected by economic, industrial, trade and tax policies.

This can have different approaches. In some countries, an agency within one of the implicated ministries designs these policies. Still, in this case, it usually does not have enough leverage to influence the agendas of the remaining ministries. In other countries, several ministries share the responsibility to regulate and promote geographies of innovation. Still, the main problem in this situation is that each has its own agendas and budgets, often uncoordinated with other ministries. A third option is that cross-ministerial agencies or interdisciplinary innovation councils undertake this task. Still, this approach only works with solid mandates for this organisation and close coordination with the rest of the government.

While it is not obvious who should be responsible for regulating all aspects related to geographies of innovation, all these policy initiatives should be aligned. A **horizontal misalignment** between policies of different agencies in a country can result in several overlapping programmes pursuing the same objective, policies pursuing contradictory objectives or a specific stakeholder group that is not targeted by any initiative. This means the horizontal misalignment present in some countries reduces or eliminates synergies between policies, reduces the efficiency of the public funds and thus reduces its potential impact.

At European level, **cluster policies** have been promoted, and a wide range of programmes, platforms and initiatives have emerged around it in the last decade (DG Growth, 2021). While current cluster policies contain elements that are beneficial for all geographies of innovation, these are too focused on a specific industry or a set of related industries and rarely consider the role of knowledge providers or societal actors. Clusters also spread across a larger area, usually a region, while geographies of innovation tend to be smaller areas.

Policies for geographies of innovation are often part of **STI policies. Another** challenge emerges because STI policies in some countries might not be aligned with the national development strategy or at the Centre of the economic development strategy (Padilla-Pérez and Gaudin, 2014; Padilla-Pérez, 2013). These policies might not be part of a strategy that addresses particular problems of the country or region but a process of imitation in which objectives and instruments might also lack alignment (Chaminade et al., 2012).

At European level, geographies of innovation have also been used as a vehicle for **Smart Specialisation strategies** (S3) (JCR, 2021). The design of the S3 is a condition of accessing resources for research and innovation for the EU Cohesion policy. In this context, two types of geographies of innovation, science, and technology parks explicitly appear as beneficiaries of S3, and three main roles were identified for them. These were the development of pilot innovation initiatives and the addition of external and outward looking dimensions to S3 as a stakeholder of the quadruple helix of innovation (Nauwelaers et al., 2014). Rissola and Haberleithner (2020) examine the role of key players in the governance of place-based innovation ecosystems being operated along some of the main elements of S3, such as the entrepreneurial discovery processes (EDP). Their research analyses and compares fives selected cases leading to the definition of diverse models of place-based ecosystems based on various dimensions, including the types of orchestrators and leading actors or the ecosystem contextualisation of S3. In another research, Rissola et al. (2019) analysed how S3 processes and methods can be linked and applied to innovation districts outside of the European Union with the aim to support EU local economic strategies.

Whether this is through ERDF or other **structural funds**, the European Commission Cohesion Policy has also supported geographies of innovation for decades, mostly science and technology parks. These have been used as a tool for creating long-term sustainable growth in some regions and reducing disparities. However, these EU efforts have not always been aligned with those of the cities and regions, losing the opportunity to create synergies between them and reducing the impact.

This leads to the challenge of **vertical alignment between policies** at different levels (international, national, regional, and local). Each government level has its own agenda, and they are not necessarily coordinated, thus preventing them from achieving the desired objectives. Policies at different levels are used depending on the aim; for example, while national policies are more suitable to achieve economies of scale, primarily through regional and local policies, policymakers genuinely adapt to the regional and local needs.

Another challenge lies in the fact that policies for geographies of innovation are not standard. The existing policies vary between countries and regions, also depending on the **participation of the government in the geographies of innovation**. According to this criterion, they can be broadly divided into three categories:

Fully private geographies of innovation, possibly run by investment groups or by real estate development partnerships, aim to reach economic benefits for the managerial organisation and the tenants in that geography. The government is not directly involved in these geographies.

Geographies led by public-private partnerships, including the participation of the private sector together with some participation of the government, can take different forms. These geographies balance private, and public objectives and governments typically let the geography meet the operating costs on a fee-for-service basis after covering the initial cost or after a few years of operation. Lund et al. (2020) provide an overview of existing public-private partnerships for science and technology parks and for innovation districts, providing a wide range of arguments for this type of arrangement, including attracting private investors, expertise, and efficiency.

Not-for profit-led / sponsored by governments. In this case, their objectives are primarily related with the industrial transformation, economic diversification, and the creation of high value employment to increase the tax base and overall, the social and economic development of its cities (DG Regio, 2014). The government dedicates specific resources, some . Some fund both the initial investment and operating costs during the whole life of the geography as social investment.

No matter the degree of government participation in the geography, governments regularly offer to organisations large sums of money in fiscal incentives, including cash grants, rebates, and tax credits, to encourage them to relocate into these geographies. The target can be innovative local, regional, national, or international organisations that can add value to the geography in their operations and their interactions with other organisations.

As part of the recent Horizon Europe programme, the European Commission has created **the European Innovation Ecosystems** initiative in order to ´build interconnected, inclusive innovation ecosystems across Europe by drawing on the existing strengths of national, regional and local ecosystems and pulling in new, less well-represented actors and territories to set, undertake, and achieve collective ambitions towards challenges for the benefit of society, including the green, digital, and social transitions´ (European Commission, 2021). Not only the European Innovation Ecosystems initiative directly targets geographies of innovation, but it is also an excellent example of horizontal and vertical alignment. This initiative is coordinated with the European Institute of Innovation and Technology (EIT), the European Innovation Council (EIC), the "Widening participation and strengthening the European Research Area" work programme and innovative activities within Horizon Europe, the Digital Europe Programme, as well as other relevant policy and funding initiatives at European, national, regional, and local level, like the Enterprise Europe Network and the regional S3.

2. Geographies of innovation: a collaborative innovation approach

2.1.The precursors of geographies of innovation

The aspect of clustering of economics activity is far from new. In 1890, Alfred Marshall already described that economic activity tends to cluster because of the presence of supporting infrastructure for the same industry, specialized skill labour and knowledge spill-overs (Crescenzi et al, 2019). The first agglomerations of factories and industrial businesses were called industrial parks and they started to emerge at that time. However, they did not become more widely embraced until the second world war, when consciousness of the benefits of geographical agglomeration was more broadly recognised.

Industrial Parks are specific geographies outside or at the edge of cities that are planned and developed as sites for factories and other industrial businesses that share infrastructures and facilities (UNIDO,1997; Walcott, 2020). The concept of industrial parks is understood by different authors in a rather standard and similar way (see Annex 1). These areas started to benefit from agglomeration economies, but the aspect of collaborative innovation was not a central goal.

The variation **Industry Cluster** is used for a similar concept, a group of factories and industrial business collocated in the same area that benefit from shared facilities and infrastructures, but it emphasises that these factories or companies belong to the same or related industries, i.e., the same supply chain (Accenture, 2020; Burke and Grass, 2019). Therefore, this concept places collaboration between the companies in the cluster as a more important goal, but often with the aim of lowering costs to achieve a better positioning in their supply chain, rather than through collaborative innovation.

Another agglomeration model emerged in the US in the 1950s and in Europe in the 1980s, with a similar aim as industrial parks but with different actors. **Business Parks** referred to the collocation of business and/or small factories in suburban areas with easy access to main roads that also aim to get a competitive advantage mostly by lowering costs (UNCTAD, 2015).

These three models share several characteristics. The business or factories in these three models do not have to be innovative or knowledge intensive. Also, they seek competitive advantage when collocating, but often through lowering costs (e.g., through shared infrastructures or labour pooling) and not through collaborative innovation. In addition, these three models are usually managed by an organization that sells or rents the properties and often provides additional services (e.g., cleaning, cafeteria, parking space), but there is not an active programming that promotes or expects collaborative activities among the tenants.

Importantly, this first era of high-density business clustering already recognised the potential benefits offered by geographical or supply chain agglomeration of organizations and all these models can be explained by theories of agglomeration. However, due to the absence of innovative and knowledge-based organizations and of collaborative innovation, in the framework of this paper these are not considered geographies of innovation, but precursors to geographies of innovation.

2.2.The concept of geographies of innovation

In the last few decades, a set of new geographies have emerged, where a wide range of organizations also collocate within or in close proximity to urban areas to obtain a competitive advantage. However, in these new geographies, clustering does not only relate to agglomeration economies and theories but also with innovation and knowledge economies and theories. Specifically, these places are related with the New Growth Theory, which emphasizes that economic growth results from the increasing returns associated with the generation and sharing of new knowledge, and it is also related with the concept of *milieux innovateurs*, which highlights the social dimension of innovation though effective relationships, social connections that enhance learning, and a deep sense of belonging (Rissola et al, 2019).

The existing literature in geography, economics, management, and public policy among other disciplines analyse and aim to develop the knowledge around these places. Some authors and organizations have used the term geographies of innovation as an umbrella concept to refer to these places (Katz and Wagner, 2014; Coenen and Morgan, 2020); however, the term ´geography of innovation´ remains ambiguous. This partly comes from the unclarity around the term ´innovation´. There are dozens of definitions of innovation but what most of them have in common is the reference to change and value. Therefore, innovation is commonly understood as ´change that generates new value´. With this base, geographies of innovation then refer to those places in which innovation happens.

Related to the concept of place-based innovation, these geographies are designed to foster sustainable regional growth based on geographical collaboration in science, technology, and innovation. Collaborative innovation is therefore a crucial element for creating a broad impact in the cities and regions where they are located, even internationally. Human capital, relationships and networks are the base of these places.

Every geography of innovation is unique. The combination of its context, its areas of specialisation, its mix of actors, its locations in respect to urban areas, its governance, etc. make these places difficult to frame (Rissola and Haberleithner, 2020). However, based on the analysis of the definition of the different types of geographies of innovation, it can be deduced that these places have some special common characteristics that differentiates them from other places where innovation might happen.

First, geographies of innovation are **planned**. There is an explicit intentionality behind the creation and development of the space to be a place where innovation happens. Behind this planning efforts, there can be governments, universities, the private sector, or a combination of these actors. At times, geographies of innovation are part of a regional innovation policy initiative or a smart specialisation strategy, ultimately planned to be engines of economic development.

Second, this planning seeks to establish a **high density** of innovative and often knowledge-based actors within this geographic area. These actors can be innovative companies, start-ups, higher education institutions, research centres and a series of other organizations (e.g. promoters, articulators, enablers, linkers) that are clustered in an area with a higher R&D density than other parts of the city and region. All geographies of innovation include innovative companies (i.e., with high levels of R&D) and most include at least one university or research centre.

Third, these geographies are actively **managed** by an organization or a consortium of organizations. The governance of the geographies of innovation can be done by a single organization (a government agency, a university, a business) or a consortium of organizations. They are responsible for establishing the strategies of the geography, obtaining financial sustainability, attracting, and retaining talent, organising networking and collaborative activities, and generally encouraging dynamism and interaction among the actors within this geography.

Fourth, and as a consequence of the prior characteristics, **collaborative innovation** activities take place. While any of the innovative organizations located in the geography can and does innovate individually, the levels of collaborative innovation are significantly higher than in their regions. Organizations move there seeking collaboration opportunities, they have similar or complementary profiles, the physical space is conducive to collaboration, and this is also promoted by the organization managing the geography.

Considering this, geographies of innovation could be defined as:

Geographies of innovation are planned and actively managed spatial clustering of a wide range of innovative organizations and intermediaries to undertake collaborative innovation activities.

Although there is no common framework for the foundations of the agglomeration of innovation, an analysis of these geographies allows to differentiate three distinctive types of geographies of innovation: science parks, technology parks and innovation districts. Table 1 below summarises their differences and similarities and compares them with the industrial and business clustering described in the first section of this document.

2.3.Models of geographies of innovation

Science Parks

After the second world war, the science contribution to the victory was obvious for the United States, so universities and/or research institutions were incorporated into their industrial concentration. In 1951, it launched what is considered to be the world's first university research park, Stanford Research Park, as a cooperative venture between Stanford University and the city of Palo Alto (Ribeiro et al, 2016). Although science parks were an American phenomenon, in the 1970s, they started in the United Kingdom with the creation of parks at Cambridge University and Heriot Watt University in Edinburgh and in France with Sofia-Antipolis. In the early 1980s the first science parks extended to other European countries, such as Italy, with the Area Science Park in Trieste (West, 1998). Since then, some science parks have been formalised based on the organic grow around existing scientific organizations (e.g., Karolinska Institute in Stockholm), while others have been planned from the beginning with a set of actors in mind.

Definitions of science parks (see annex 1) highlight that the most important characteristic of a science park is that it revolves around research, whether this comes from higher educational institutions (HEIs) or research centres. In the United States, science parks are often called research parks or university research parks (if led by a university). If both universities and research centres are present, it is common that they undertake collaborative research. These science-based organizations are often surrounded by a series of high-tech or research-oriented companies, although this is not always the case. The companies move there to develop closer ties to the HEIs or research centres and tend to be from sectors in which the HEI or research centre is particularly strong (DG REGIO, 2014).

These actors in the park regularly collaborate in research, whether this is research consulting, joint research, or business-funded research projects. In addition, the commercialization of research results (Galán-Muros and Davey, 2019) translate into innovation based on R&D for companies (UNCTAD, 2015). Companies can also collaborate with the universities in the codesign and codelivery of the curriculum of the study programmes, as well as through internships, student projects or lifelong learning courses to the company employees (Plewa et al., 2015).

In addition, the creation of technology-based firms by universities or research centres is also common (Dabinett, 2014) and their location in the park gives them a comfortable landing pad and opportunities to establish relationships with the companies in the park since the early stages. Amoroso et al have explored concrete ways to systematically collect information on public and private organizations related to the support of science and technology parks – also relevant for the next section - through collecting evidence on the impact of such parks on regional development (Amoroso et al, 2019). Rissola and Haberleithner (2020) provides a throughout synthesis of various place-based innovation eco-systems, in which they examine Lindholmen Science Park in Gothenburg that is considered to be a key player that channels collaborations and that represents a platform for cross-disciplinary and cross-industry projects.

Technology Parks

In the mid-1980s, technology parks also started emerging in Europe, with examples such as the Technologiepark Heidelberg in Germany and Bizcaia Technology Park in Spain. The main difference with the science parks is that they revolve around the development of advanced technologies and they are frequently aligned with policies to stimulate economic development by getting away from traditional declining industries and focusing on high-tech ones (Nauwelaers et al., 2014).

Definitions of Technology Parks (see Annex 1) agree that these parks located at the edge or outside cities include a set of technology-based companies and are focused on development, design, and production. The companies located in these parks are normally from similar or complementary sectors and the park provides some value in contrast to industrial or business parks, while some degree of collaboration between them is expected.

These geographies do not need to include HEIs or research centres but many of them do so, even if there is only one or a few faculties of a university located in the park. These are usually those faculties more aligned with the sectors of the companies in the park (e.g., engineering, computer science, biotechnology). When this happens, the opportunities for more radical innovation increase based on university-industry collaboration activities (Davey et al., 2017), as described in the science park section above.

One of the most successful technology parks in Europe is Kista, in the northwest of central Stockholm. It was created in 1986, when Ericsson and IBM located their offices there; nowadays, it is the leading European ICT cluster, and it is home-based of 1000+ companies. Prominent HEIs such as KTH and the University of Stockholm opened a campus in Kista to host their ICT related degrees and research.

At times, the concepts of science park and technology park are used together, and some geographies of innovation are called science and technology parks, to emphasise the equal focus they give to scientific knowledge and high technology. Rissola and Haberleithner (2020) in their publication on place-based innovation eco-systems, analyse the Technology Park Ljubliana that is considered as an 'innovation process entrepreneur in Slovenia dedicated to the development of the innovation eco-system.

Innovation Districts

The most recent model of geographies of innovation are innovation districts. The first geography recognised as an innovation district is Barcelona 22@ in Spain. Established in 1998, 22@ implied a territorial transformation on three aspects simultaneously: urban, social, and economic. It was designed to regenerate the old industrial area of Poblenou and through public-private partnerships it currently hosts over 8,000 firms and 90,000 employees together with a wide range of amenities and housing. Barcelona 22@ stated to be an inspiration for many others, but the concept of innovation district was popularized in a 2014 publication of Brookings Institution (Katz and Wagner, 2014).

This model differs from the other geographies of innovation in several key aspects. From a physical space perspective, innovation districts are usually located within cities or at the edge of cities but well connected to it. Sometimes, innovation districts are the result of urban redevelopment and are actively connected with the communities around them. In addition, it is the one which places more emphasis on the physical space, putting large efforts to make it porous, attractive, walkable and include green spaces (Wagner et al., 2019).

An innovation district is the model that includes a wider variety of actors (i.e., HEIs, research centres, start-ups, innovative corporates, intermediaries, third places and housing) and they revolve around one or several anchor institutions. These districts are actively managed by an organization that places a large emphasis on innovation and human capital to attract the right mix of organizations and talent to the district. Rissola and colleagues argue that innovation districts act as enablers for place-based innovation (Rissola et al, 2019). Rissola and Haberleithner (2019) in their publication on place-based innovation eco-systems examine Seaport and Dudley Square in Boston and Kendall Square in Cambridge which are considered to be interconnected macro-innovation eco-systems.

Lund et al. (2020) have examined the application of public-private partnerships and similar modalities to the development and sustainable operation of science and technology parks and innovation districts. This analysis serves as a base for conducting further research on developing new hybrid financial models for innovation districts, thereby contributing to urban innovation districts becoming the engines of urban transformation and sustainable and inclusive growth.

In addition, this organization designs the strategic view for the district and builds an active programming to bring stakeholders together, whether this is through formal collaborations, social networks, and even informal serendipitous encounters (Wagner et al., 2019). These districts have a high potential for innovation and to have large social and economic impact. Some districts are taking responsibility for this aspect and acting as engines for social and economic development of their cities and regions across the world. Some innovation districts have proven to make a major difference in their cities even within unfavourable contextual conditions when they were established. A clear example of this is the city of Medellin (Colombia), once the most dangerous city in the world and today one of Latin American main innovation hubs (see Box 1).

Box 1: Innovation districts and engines for development. The case of Ruta N

Ruta N is an innovation district in Medellin (Colombia) designed in 2012 by public policy developed by the local government that called for the cooperation of society, business, and universities, with the intention of promoting innovation and the development of science and technology as a basis for the city's economic growth.

The Science, Technology, and Innovation Plan laid the foundations for the development of Ruta N around four strategies: (i) The training and development of human resources, (ii) Access to financing, (iii) Business development, and (iv) The creation of spaces for innovation.

These strategies were accompanied by the creation of the Great Pact for Innovation, which encouraged investment in innovation by the private sector, as well as the creation of the Innovation District in three neighbourhoods of low income.

Therefore, Ruta N was born as an engine of social and economic growth and many of their indicators are related to the benefits for the city (e.g., companies and investment attracted to the city, creation of jobs, strengthening local companies, the organization of challenges to meet urban needs, etc.). Ruta N Innovation District has the potential to become the main innovation hub in Latin America.

Source: Ruta N (2021)

Table 1 at the end of this section summarises the main characteristics of the five models described until now, the two precursors (industrial and business parks) and the three geographies of innovation (science parks, technology parks and innovation districts). This is a generalisation of the very complex reality for simplification and analysis purposes, but precisely because of the lack of common definitions, the reality can differ.

Other associated terms

Geographies of innovation across Europe and around the world have also referred to themselves with different concepts to the ones described in this document or include associated terms to describe their activities. This section aims to briefly cover the most common ones.

One of the most common ones is 'cluster', a term popularised in 1998 by Michael Porter, who defined them as 'concentrations of interconnected companies and institutions in a particular field that compete but also cooperate' (1998, p. 78). However, can vary significantly in size and can work at different levels (i.e., local, regional, national or even international) and often cut across boundaries. This is where colocation is not always a requisite and for the last decade in Europe, the concept of virtual cluster has been used (Flores and Molina, 2020). The European Union has a cluster initiative that includes among others an observatory, an expert group, a collaboration platform, and specific policy to support regions in their industrial transition to develop new approaches that restore their growth and productivity.

The concept of 'hub', that literally is "the effective centre of an activity, region, or network", has also been used within geographies of innovation, but its real meaning and definition has been difficult to pin down. Generally, literature describes a hub more like a community of practice, a network, or a platform (STEM Foundation, 2020) not necessarily for exploiting capabilities, concentrating investment and stimulating companies. It is often accompanied by the word innovation. Specifically, European digital innovation hubs take the role of knowledge brokers.

Digital Innovation Hubs operating in diverse regional context across Europe and beyond seen as policy instruments boosting digitalisation of SMEs (Kalpaka et al, 2020). While European Digital Innovation Hubs are considered to be playing a central role in stimulating the uptake of technologies such as cybersecurity, artificial intelligence, high performance computing, etc after the program launch by the program (European Commission, 2021). As a national example for the implementation of digital innovation hubs, in Italy, and potentially in other European countries, they support the digital transformation of SMEs by triggering open innovation practices (Crupi et al, 2020). In general, hubs are believed to have the following characteristics:

(i) collaborative communities are built with entrepreneurial individuals at the Centre

(ii) They attract an heterogenous group of people with diverse knowledge

(iii) Hubs facilitate collaboration and creativity in both a digital and physical space

(iv) Hubs localize global entrepreneurial culture (Toivonen and Friederici, 2015).

In addition, the concept of place-based innovation ecosystem has also been used to refer to the innovation that occurs in a specific geographical area, with a particular emphasis to the variety of actors in the quadruple helix that are involved, actively participate, and interact in synergetic relationships. This term also highlights the application of a bottom-up approach that through a strategy exploits niches and new engagements for the specific and unique resources of a city or region. In this way, place-based innovation ecosystems connect with Smart Specialization Strategies (Rissola et al. 2019; Rissola and Haberleithner, 2020).

More recently, some geographies of innovation have used the terms 'quarters', 'cities' or 'precincts'. Firstly, Quarter has been used more commonly for those geographies of innovation located in a part of a town or city (e.g., Knowledge Quarter Liverpool) in order to highlight having a particular character or use (ARUP, 2018). This concept is more likely to be synonym with the definition established here of innovation districts. Secondly, the word 'city' is also used by some geographies of innovation (e.g., Copenhagen Science City) even when this is only a section of the city where it is located. Despite their name, these geographies are not bigger than others.

Last, innovation precinct (e.g., Tonsley Innovation District) is a term coined in Australia, whose government defines them as “place-based innovation ecosystems” whose geographic extent is widely understood, provides a sense of belonging to those involved in the precinct, establishes strong informal and formal networks and partnerships among those people and organizations involved (Department of Industry, Innovation and Science. Government of Australia, 2018).

The following sections include a comparative case study analysis including a set of six case studies of geographies of innovation from two cities to produce evidence that supports the development of future European, national, or regional policies in Europe, so the current and future geographies of innovation enhance their performance and contribution to a greener, cleaner, more social and more developed cities and regions in Europe and beyond.

Table 1: Summary of the characteristics of each of the five models described

		INDUSTRIAL PARKS	BUSINESS PARKS	SCIENCE PARKS	TECHNOLOGY PARK	INNOVATION DISTRICT
	FOCUS	Manufacturing	Business Offices	Research	Development	Collaborative Innovation
PHISICAL	Location	Outside city	Outside city	Outside city	Outside city	Inside city (or well connected)
	Shared infrastructures	No	No			Common
	Quality of place	Low	Low-Medium	Medium	Medium	High
	Walkability	Low	Low	Medium	Medium	High
ACTORS	Density of actors	Yes	Yes	Yes	Yes	Yes
	Most common/leading actor	Factories	Business offices	Universities and/or research centres	High-tech business	Mixed
	Presence of university/R.C.	No	No	Yes	Often	Yes
	Presence of innovative business	Not required	Not required	Often	Yes	Yes
	Presence of incubators/accelerators	No	No	Maybe	Maybe	Yes
	Presence of third places	No	No	Maybe	Maybe	Yes
	Presence of housing	No	No	No	No	Likely
	Variety of actors	Low	Low	Medium	Low	High
OTHERS	Relationship with community	No	No	No	No	Yes
	Governance and programming	No	No	Limited	Limited	Active
	Collaboration	No	No	Yes	Yes	Yes
	Potential for innovation	Low-medium	Low-medium	High	High	Very high
	Alignment with policies	Industrial policy	Economic policy	Science-based development	Technology-based development	Innovation-based development

3. Case studies of geographies of innovation

In the last decades, so called geographies of innovation have emerged all around the world as vehicles to drive economic development. Even when there is not a common definition, geographies of innovation could be defined as planned and actively managed spatial clustering of a wide range of innovative organizations and intermediaries to undertake collaborative innovation activities.

This case-study comparative analysis includes a set of thirteen case studies of geographies of innovation located in four cities of four different countries, three European city and one city outside Europe. The purpose of this analysis is to produce evidence that supports the development of future European, national, or regional policies in Europe, so the current and future geographies of innovation enhance their performance and contribution to a greener, cleaner, more social, and more developed cities and regions in Europe and beyond.

This section presents one city and the geographies of innovation within or nearby that specific city. Therefore, the cases have two levels:

- the geography of innovation level, in which the main information of each geography is synthesise and analysed individually and with the same dimensions and structure,
- the city level, which takes a broader perspective of the city, compares their geographies and presents some local insights.

The three European cities selected are:

- Stockholm (Sweden)which has the largest ICT cluster in Europe and the three largest in the world (Kista Science City), complemented by one research-led (Karolinska Institute Science Park) and one industry-led (Sodertalje Science Park) geographies.
- Barcelona (Spain), which hosts four geographies of innovation of different nature within the city (Barcelona Activa Technology Park, Polytechnic University of Catalonia Park, Barcelona Science Park, and 22@ Innovation Districts) and another one nearby (El Vallés Technology Park).
- Amsterdam (The Netherlands), which includes three geographies of innovation around its main higher education institutions: Amsterdam Science Park around University of Amsterdam, Zuidas Knowledge Quarter around VU Amsterdam and the emerging Cumulus Park around Amsterdam University of Applied Sciences.

The city from outside Europe is Melbourne (Australia) and it has been chosen for its large efforts and dynamism in building geographies of innovation within the city and the Greater Melbourne area, mostly around their universities, but also around industrial complexes. The three geographies analysed in this report are Melbourne Innovation Districts, Monash Employment Cluster and Fishermans Bend.

Each one of the cases is unique in its origin, development, actors, and dynamics, they are linked to Smart Specialisation or Regional Development Strategies differently and implement a Quadruple Helix Model in a different way. However, all of them have an impact in the social and economic development of the cities where they operate and beyond. This shows that there is not a one-size-fits-all approach for geographies of innovation, but instead a set of guidelines and key success factors that should be considered in the establishment and development of each geography and that are summarised in the last section of the report.

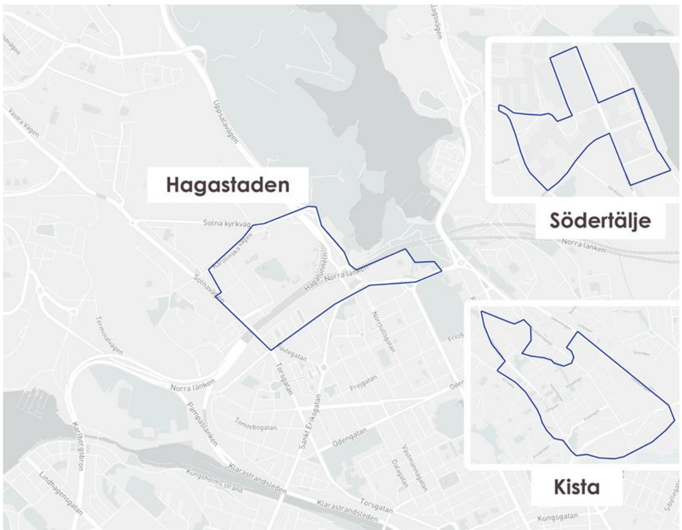
3.1.Stockholm (Sweden)

The Stockholm region is the second most innovative in the European Union, only after Helsinki (Regional Innovation Scoreboard, 2019). The capital city is a well-known innovation hub, and this is often done with a quadruple helix approach. Initiatives such as Digital Demo Stockholm (DDS) show the power of the innovation partnership between the government, academia, and the private sector. In this case, DDS leverages digital solutions to facilitate and improve the citizens' quality of life (Digital Demo Stockholm, 2021)

Stockholm has an explicit innovation strategy and dedicated funding to support innovation capacity. The city approaches innovation capacity both from a holistic level, as well as in specific policy areas (Bloomberg Philanthropies and OECD, 2021). The city is home of highly reputed higher education institutions, and a large network of start-ups and successful corporations. Stockholm is the third European city in patent applications (OECD Regpat database) and was named the world's smartest city during the Smart City Expo World Congress.

Stockholm has three geographies of innovation within the city: Kista Science City, the leading ICT cluster in Europe and the third largest in the world. Karolinska Science Park, led by Karolinska Institutet but currently integrated in the new development area of Hagastaden and Sodertalje Science Park, set in 2018 in the nearby city of Sodertalje and around the headquarters of two large corporations located there for over a century.

Figure 1 Stockholm Geographies of Innovation



Source: Own Elaboration

3.1.1. Kista science city

Kista is the largest ICT cluster in Europe and third largest in the world. Today Kista hosts almost a thousand companies, including start-ups and spin-offs, and over 35.000 people work there, approximately 19.000 of those in ICT. Kista has had a large impact in Stockholm city, region, Sweden, and Europe (Kista Science City, 2021a).

Leadership and governance

Several social actors representing all the helices of the triple helix came together to promote a special vision for the Kista area and established Electrum Foundation to encourage more effective collaboration (Stockholm Discovery, 2021). Electrum Foundation, which is 100% funded by the City of Stockholm, is active in higher ICT training, global growth, and innovation. The board of Electrum Foundation includes representatives from the City of Stockholm as well as company leaders of Ericsson, Acreo, IBM, Atrium Ljungberg, PacketFront and the university KTH (Swedish Testbeds, 2021). The geography is managed by Kista Science City AB (KSCAB), a non-profit organization whose mission is to promote and develop the Kista Science City region. The mission of KSCAB is to make Kista Science City ‘a place where people and business can continue to develop’ by encouraging strong cooperation between academia, industry, and the public sector. The values of “Love, Commitment and the Future is here” lead KSCAB to pursue their vision (Runiewicz-Wardyn, 2009).

Physical space

Kista Science City is located in the district of Kista, northwest of central Stockholm. The planning of Kista started in the 1970s to become a town with a residential and commercial area, but when SRA and IBM located their offices there, it turned into a more industrial area that aimed to host the headquarters of main telecom industry players in Sweden. The main growth of Kista happened in the 1990s, when some research labs and university departments settled there (Runiewicz-Wardyn, 2009).

The current physical landscape of Kista is well-planned and very diverse. It includes iconic buildings such as Electrum Building, which included office space, lecture halls, and laboratories of the two universities and the city of Stockholm or the 32-storey Kista Science Tower. It is the second tallest building in Sweden that used to be the tallest in Scandinavia when built in 2003. Kista also has small-scale business premises, and in the early 2000s some intermediaries or enablers were established there as well, such as the incubator STING (Kista Science City, 2021b). There are plenty of opportunities for people and organizations to interact, as many of the Kista buildings are shared between several organizations (e.g., Kista Science Tower) and several coworking spaces offer space for small companies to rent (e.g. Helio Co-working, C/O Kista, NOD House, Quick Office, First Office).

The location of Kista between two airports and two European roads, 20 minutes by metro from Central Stockholm, and 10 minutes from Odenplan by train is very strategic and attractive (Kista Science City, 2021b). Kista's industrial, research and educational zones are surrounded by green areas and recreational spaces, shops, restaurants, hotels, a shopping centre (Kista Galleria) and a public transportation junction. There are walkable paths and specific bike roads.

Organizations and talent

Kista includes a wide range of stakeholders, and it has several anchor institutions of each type. In respect to business, Kista hosts almost 1.000 companies and two thirds of them are from the ICT sector. The two anchor companies were Ericsson and IBM Svenka and the rest of the leading firms in Kista by number of employees are: Tele2 Sverige AB, CGI Sverige AB ,City of Stockholm, Atea Sverige AB, Coor Service Management AB, Swedish Defence Research Agency, FOI, Telefonaktiebolaget LM Ericsson, Fujitsu Sweden AB, Intertek Semko AB, Philips Aktiebolag, Alten Sverige AB, Huawei Technologies Sweden AB.

Two leading Swedish HEIs have campuses in Kista. The Royal Institute of Technology (KTH) was founded in 1827 and is one the Europe’s leading technical and engineering universities. Its Kista Campus hosts the KTH School of Information and Communication Technology and has 1.700 students. The University of Stockholm is the largest university in Sweden and one of the top 100 universities in Europe, according to the Academic Ranking of World Universities. In Kista, the campus hosts 5.100 students and the Computer and Systems Sciences (DSV) Department. Both HEIs undertake education at undergraduate and postgraduate level and research in a wide range of high-tech areas mainly related to ICT (e.g., quantum electronics, semiconductor physics, computer systems, software development, communication system, optics, IT security, etc.) (Kista Science City, 2021c).

In the area, the three high schools focused on ICT and innovation (Stockholm Science and Innovation School, Tibble Gymnasium and Thoren Innovation School) complement the education offer. There are a series of research centres across Kista, some of which belong to one of the universities., others are in collaboration with industry (e.g., Electrum Lab) and others state-owned or independent (e.g. RISE) (Kista Science City, 2021c).

Kista also hosts a wider range of intermediaries that connect the other actors or support them in their operations. The managing organization, Kista Science City AB, also coordinates several of the networks, projects, events and venues, Urban ICT Arena support organizations in Kista offering the main space to develop products and showcase solutions, together with events and seminars (Kista Science City, 2021d). STING, the most successful tech accelerator in Sweden, is in Kista too, as well as Stockholm's Teknikhöjd, which supports the two universities in the commercialisation of research and business ideas (Runiewicz-Wardyn, 2009). Kista Business Network offer a space for experience exchange among SMEs, through meetings and activities, and the two centres of the international network Innovation Relay Centres offer services for companies, especially for SMEs (Kista Business Network, 2021).

Talent is critical for Kista Science City and beyond their individual initiatives, all organizations come together to attract and retain talent with a series of actions promoting the Stockholm region as a world IT cluster. A wide range of companies in Kista, Kista Science City, plus the Stockholm County Council, the Electrum Foundation, Stockholm Science City Foundation or Stockholm IT Region join forces for talent programmes (Runiewicz-Wardyn, 2009).

Innovation and collaboration

Some companies within Kista have internal R&D departments and valuable IP, which allow them to innovate and lead fast-moving competitive industries.

However, a large part of the innovation within Kista is collaborative innovation. Kista has the complete innovation ecosystem present, from university labs that undertake basic and applied research, to testbeds and demonstration environments to the use of Kista itself as a testing or pilot ground for many of the technologies developed, including 5G and IoT technologies. Then, either start-ups, spin-offs, or highly innovative corporations in Kista can take those technologies to market (Kista Science City, 2021b).

Collaborative innovation is facilitated by the shared labs (e.g., Electrum Lab by KTH and Acreo), shared buildings (e.g. Electrum building is a thriving base for researchers, students and entrepreneurs) and co-working spaces as well as the many other places that allow serendipitous encounters.

3.1.2. Karolinska Institutet science park / Hagastaden

Karolinska Institutet science park (KISP) is a life sciences science park located around Karolinska Institutet and currently being integrated into the new development area of Hagastaden, described as 'a Science City for Life and Health'.

Leadership and governance

KISP is a high-quality and international business enabling environment that facilitates the growth of start-ups and of consolidated companies in life sciences by supporting the commercialization of R&D to benefit healthcare. KISP is part of the Karolinska Institutet innovation system, and its vision is to 'become a leading arena within life sciences' (KI Science Park, 2021a).

The Park is managed by KI Science Park AB, founded in 2003 as a wholly owned subsidiary company of Karolinska Institutet Holding AB, owned by Karolinska Institutet. The main objective of KI Science Park AB is to promote the establishment of innovative companies in the park, support them to commercially develop their scientific ideas as well as facilitate the interaction with the rest of the organizations within the KI innovation system (KI Science Park, 2021a). KISP has a close collaboration with the Royal Institute of Technology (KTH) and Södertörn University College, located in Flemingsberg.

Physical space

KISP is located next to Karolinska University in the northern Stockholm neighbourhood of Solna, but there is a delocalized building in the southern part of the region, in Flemingsberg (KI Science Park, 2021b). The total area is around 22.570 square meters (KI Science Park, 2021a).

The majority of the space in the park are modern office premises, first class laboratory facilities in collaboration with Akademiska Hus (a real state public company focused on education and research) and Karolinska Institute. Over 60 companies are established on KISP, particularly on pharmaceuticals, medical technology, and health production (KI Science Park, 2021a). In addition, the park includes restaurants, bookstores and hotels located in the area and this offer will only increase with the integration of KISP into Hagastaden, a 96-hectare new development area of the city. Its construction started in 2010 but will not finish until 2030 and then is expected to include 6,000 apartments mostly in tall buildings including some signature buildings. More restaurants, shops and other amenities are being built, and street art is being designed to make the area even more attractive. At the end of the development 50,000 workplaces are estimated, half of which will be in life sciences (Stockholms Stad, 2021).

KISP is currently well connected, but this will also improve and Hagastaden will have four subway exits, three Bus Rapid Transit lines, and other bus lines. A large park is being built in the core of Hagastaden that will act as a green corridor between Stockholm and Solna. There will also be a distinctive green link between Hagaparken and Karlbergsparken.

Main Actors

The main anchor institution of the park is Karolinska Institutet, one of the world's leading medical universities with the largest variety of medical programmes and the largest share of medical academic research in Sweden (Karolinska Institutet, 2021a). Some academic unit at KI are specially connected with the park, such as the Unit for BioEntrepreneurship (UBE) that undertakes research on and education in innovation and entrepreneurship (Karolinska Institute, 2021b).

KTH also has a campus in Solna to undertake research and education in life sciences areas such as: genomics, proteomics, metabolomics, diagnostics, bioinformatics, etc. (KTH, 2021a). These two universities, together with Stockholm University share SciLifeLab . These national research facilities in biomedicine, ecology and evolution are open for researchers of all universities, companies, and government users (SciLifeLab, 2021).

The two universities, together with other local universities and government agencies also collaborate in OpenLab, a nearby centre that brings students, educators, and researchers together to solve societal challenges (OpenLab, 2021). There are other research centres such as Karolinska Trial Alliance (KTA), a clinical research Centre that specializes in clinical studies (KTA, 2021). Karolinska University Hospital is another key actor in the park, which interacts with other organizations through its innovation site, Innovationsplatsen Karolinska (Innovationsplatsen Karolinska, 2021).

Karolinska Institutet Science Park AB manages the park and closely works with the investment department of KI, Karolinska Development AB. Intermediaries and enablers facilitate the interactions and support for actors, such as KI Innovations, an incubator wholly owned subsidiary company of KI that supports ideas and early-stage companies in life sciences. A community is starting to grow in Hagastaden, but at the time of writing the report, it is still early to describe it.

Innovation and collaboration

Karolinska Institutet is a highly innovative higher education institution, with the largest share of publications in the top 10% in Sweden. It is also a very open one, and 90% of their publications are made with co-authors from outside Karolinska, and over 8% are industry partners. Karolinska Institutet tends to collaborate locally as well, since around 13% of its publications are with partners in a radius of 100 km (See Annex 2). KTH is one of the main research and innovation partners for Karolisnka, as well as the newly created and mature companies in the Science Park. The shared spaces and initiatives enhance this collaborative innovation.

3.1.3. Södertälje Science Park

This recent Science Park located in Södertälje, a town in the southeast of Stockholm, was inaugurated in January 2018 and is focused on sustainable production (SSCP, 2021a).

Leadership and governance

The goal of the park is to 'strengthen the conditions for advanced production in Sweden', whether this is the industrial production of physical goods (e.g., medicines, food and trucks) or the production of services, such as transport, insurance or healthcare (SSCP, 2021b). The Park is managed by Södertälje Science Park AB, a private company whose mission is 'to create an attractive meeting place, initiate and run projects' around sustainable production flows in Sweden by attracting companies and government authorities to continue developing the area (SSCP, 2021c).

Physical space

A part of the area that today constitutes Södertälje Science Park was already developed. The municipality of Södertälje has traditionally been an industrial site and a logistical hub for land and sea traffic. Science Park was officially inaugurated in January of 2018 around facilities of the company AstraZeneca, which was founded in Södertälje in 1913, and the company Scania, which has been headquartered in Södertälje since 1912. Both companies have large manufacturing facilities in the park (SISP, 2018).

Over 20 years ago, KTH Royal Institute of Technology founded its Södertälje Campus and in 2017, a new modern attractive building started its operation, which has doubled the capacity of this campus (KTH, 2021b). There is not a large offer of restaurants, shops, or other amenities in the park as the corporations and the university tend to have their canteen inside their premises. There is no housing inside the limits of the park and the closest community lives in the centre of Södertälje but is physically separated by main roads. The walkability of the park is low and is accessible via public bus (5 lines).

Main actors

Södertälje Science Park has three anchor institutions: two large companies and one higher education institution (SSCP, 2021d).

Scania is one of the world's leading manufacturers of trucks and buses for heavy transport as well as industrial and marine engines. Scania's R&D is concentrated in Södertälje, together with some manufacturing activities. AstraZeneca, a global, innovation-driven biopharmaceutical company that operates in over 100 countries and is focused on R&D of prescription drugs. The presence of Scania and AstraZeneca has attracted other small manufacturing and biomedical or pharmaceutical companies (SSCP, 2021d).

Royal Institute of Technology (KTH) is Sweden's largest university for technical research and education and one of the leading technical universities in Europe and Södertälje is the smallest of its five campuses. With a capacity for 1,200 students after its recent major expansion, this KTH campus offers bachelor and master education programmes and undertake research in sustainable production areas (SSCP, 2021d). Apart from KTH, CampusTelge offers postsecondary polytechnic education in areas aligned with those of the surrounding industry (SSCP, 2021e).

Innovation and collaboration

KTH is a very innovative university (see Annex 2), quite open to collaborate in research with other organizations (i.e., 85% of its papers are with external partners). The education and research programmes of KTH Södertälje campus are closely developed with the industry in the park, particularly Scania and AstraZeneca, which also make a joint investment in some of these programmes: industrial reliability, production logistics and production management.

KTH also organizes open seminars in areas such as digitalization, sustainable production and entrepreneurship attended by company representatives or employees and the annual Science Week is also a good opportunity to organize joint activities and discussions around mutually interesting topics.

Södertälje Science Park is also involved in projects with other organizations, such as DigiMission (2019 – 2020) aimed to improve digitalization of SMEs, led by Mälardalen Industrial Technology Centre, with Mälardalen University, Eskilstuna Factory Association and SVID. Together with Kista Science City and KTH, the EU-funded project Frontrunners for Sustainable Innovation aims to help SMEs to develop their ideas faster and bring their innovations to market. Together with KTH, they collaborate in Open Prototyping Södertälje to open the prototype workshop for everyone and also in Production Angels, to support hardware start-ups to transition from prototype to production and scale-up (SSCP, 2021f).

3.2.Barcelona (Spain)

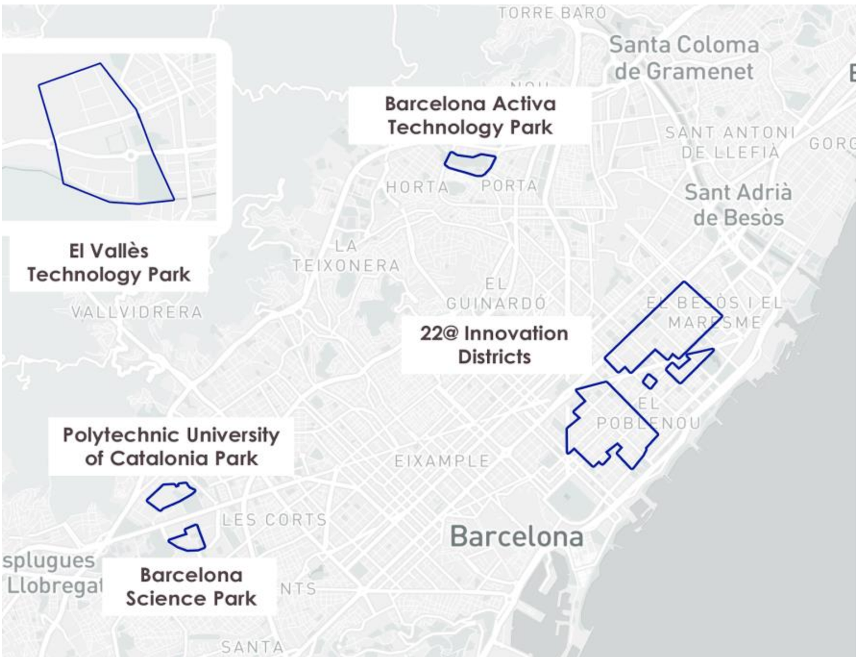
Barcelona is Spain's second largest city and capital of the autonomous community of Catalonia. The city has positioned itself as one of the most attractive European cities for the creation and establishment of start-ups (Atomico, 2021).

It's local government, aiming to make the capital "the world's leading digital city", has promoted environmental and urban policies that focus on smart city innovation (smart traffic management, free public Wi-Fi, an open data initiative…) (Dynamic, 2021). Some of its initiatives are Barcelona Activa, which helps start-ups raise funds to set up a business; or Barcelona Tech City, the city's association of start-ups and scale-ups working in ICT (Government of Catalonia, 2021).

Several international congresses and fairs, as well as hundreds of tech events covering interesting topics for start-ups, are held every year in the city: Barcelona has been hosting Mobile World Congress since 2006. It promotes a parallel event dedicated only to start-ups, 4YFN, which attracts 12,500 attendees and features 500 start-ups. Moreover, Barcelona also hosts the Smart City Expo World Congress (Government of Catalonia, 2021).

The city of Barcelona has 4 geographies of innovation, all of them within 80.75 km2. Moreover, separated from Barcelona by the Collserola Natural Park, there is an additional one: the Science Park of El Vallès.

Figure 2 Geographies of innovation in Barcelona



Source: Own elaboration

3.2.1. El Vallès Technology Park – Parc Tecnològic Del Vallès (PTV)

The PTV was founded in 1987 and it is mainly focused in the following areas: ICT, microelectronics, technologies associated with the production and processing of new materials, energy and environmental technologies, chemistry, and biotechnology. The area is home to half the pharmaceutical industry in Spain (Barcelona Field Studies Centre, 2021, Garganté, 2014).

Leadership and Governance

The Park is managed by the corporation Parc Tecnològic del Vallès S.A., which was created in 1987 by the CIDEM (Centre for Business Innovation and Development) and the Barcelona Education Consortium. Nowadays, more organizations participate in the corporation, such as the Town Councils of nearby municipalities, as well as the Autonomous University of Barcelona (UAB) (Barcelona Field Studies Centre, 2021).

Parc Tecnològic del Vallès S.A., envisions the park as "a technology promotion and development business centre". In this context, the main objectives of the corporation are (i) to attract companies and entrepreneurs whose activities are grounded on technical or scientific knowledge, (ii) promote the formation of synergies between these firms, and (iii) encourage the development of technological business projects.

Physical Space

The Parc Tecnològic is located in Cerdanyola del Vallès, a municipality located within the metropolitan area of Barcelona and next to the Collserola Natural Park, thus offering the benefits of both the big city and nature.

The land in which the park is located, a total area of 58 ha, is owned by Parc Tecnològic del Vallès S.A., which is in charge of the development and exploitation of the site.

Following the most influential trends of the moment in which the park was built (the late 80s), the park was designed under the idea that the synergies created due to physical proximity would encourage the technological development of the firms set at the park (Parc Tecnològic Del Vallès, 2021a). However, less importance was given to other factors whose relevance has been highlighted more recently (place attractiveness, walkability, mixed-use of the land, or the presence of amenities, among others). Thus, the place was designed to be accessed by car, and most of the buildings and workplaces do not encourage collaboration.

The park is 10 km away from Barcelona, 10 km away from Sant Cugat and at a distance of 35 km to the airport. It takes 30 minutes to arrive from Barcelona by car. Using public transportation, it takes 1 hour to reach the park, either by train (R4, R7) or by bus (A4, B2, B7, SU1) (Moovit, 2021; Parc Tecnològic Del Vallès, 2021d).

Main actors

Most of the actors in the park are businesses. The park hosts a total of 138 firms, from which 30% are international companies. The list includes Zehnder Group, Kymos Pharma Services, AB Electronics, or NEOS Surgery, among others (Parc Tecnològic Del Vallès, 2021b).

There are no higher education institutions or research Centres in the park. However, the main campus of the UAB, a leading public university closely linked to many research activities, is just 5 minutes by car. UAB is also part of the management organization of the park (QS Top Universities, 2021; UAB, 2021a).

In a similar manner, the closest research Centre (4 minutes by car) is the Alba Synchrotron Light Source, which is a synchrotron (a particular type of cyclic particle accelerator) located in the Parc de l'Alba (also known as the Barcelona Synchrotron Park) (ALBA, 2021).

Despite the proximity of these academic and research Centres, a private vehicle is needed for the displacements, making it difficult for some people to access them.

Innovation and Collaboration

There is no public information available about partnerships among the firms settled at the park, neither the management organization enhances cooperation by the creation of collaboration platforms and programs (Parc Tecnològic Del Vallès, 2021a). However, the UAB and the ALBA Synchrotron promote some collaborative projects.

For instance, ALBA Synchrotron organized more than 40 events and 15 workshops last year in 2018, and collaborated in research projects with several institutions, such as the chemical company BASF and a group of scientists from the Polytechnic University of Catalonia (ALBA, 2019).

A collaboration agreement was signed in 2013 by ALBA and the UAB, which holds leading global positions in the most prestigious university rankings. The University enhances knowledge transfer through the publication of patents, the promotion of collaborative research and the creation of new technology-based start-ups (UAB, 2021b). The UAB has the 6th largest national share of publications with a geographical collaboration distance of less than 100 km (see Annex 1).

3.2.2. Barcelona Activa Technology Park

The Barcelona Activa Technology Park was founded in 1995. It mostly focuses on the following sectors: digital economy, ICT, sustainability, and design (Barcelona Activa, 2021e).

Leadership and Governance

The Technology Park is managed by Barcelona Activa, the city's local economic development agency, whose main objectives are the promotion of economic growth and employment generation in Barcelona. The vision of the agency is "to make Barcelona an international reference city for working, entrepreneurship and living with social and environmental values" (Barcelona Activa, 2021b).

Specifically, the objectives of the Technology Park as a strategic component of Barcelona Activa are the following: (i) promoting responsible business growth, (ii) fostering business innovation, and (iii) talent development linked to technology (Barcelona Activa, 2021e).

Physical Space

The Technology Park (10,000 m2) is located in the Nou Barris district, a residential area located in the north of Barcelona. The buildings of The Barcelona Activa Technology Park are inside of the Parc Central de Nou Barris, a 17 hectares green space (Barcelona Turisme, 2021). The Technology Park is accessible by public transport - metro L3 and L4, buses, as well as by bicycle.

Actors, Innovation and Collaboration

Inside of the Technology Park is the Centre for Technology Companies. The Centre currently hosts 41 companies focused on highly innovative sectors such as med-tech or advanced engineering solutions in the field of renewable energy and sustainability (Barcelona Activa, 2021d).

Barcelona Activa offers a huge range of services to all the technology-based firms in the city and not only to those located in the park. It manages three incubation facilities (specialized in different types of firms and their respective necessities), offers training and assistance to entrepreneurs through the Business Prototyping Support Service, and allows access to public and private financial resources (Barcelona Activa, 2021c and Barcelona Activa, 2021a).

Barcelona Activa, in collaboration with other entities, organizes more than 100 innovation-related events annually, including investment forums, networking events, or marketplaces (Barcelona Activa, 2021c). Moreover, it offers several spaces that can be rented to organize different activities and events, such as the Espai Barcelona in the OAE (located in the innovation district 22@ Barcelona), and the Auditorium in the Technology Park (Barcelona Activa, 2021c).

To sum up, Barcelona Activa removes physical barriers and aims to transform the whole city of Barcelona into an innovation ecosystem by connecting all the agents and geographies of innovation of the city.

3.2.3. 22@ Innovation District

Formerly an industrial district, El Poblenou (also known as "the Catalan Manchester" in the 19th-century) embarked in 1998 in a regeneration project to transform the neighbour into a pole of business, scientific, technological and cultural activities, with a balanced mix of land uses. The Barcelona City Council anchored the project through a renovated 'General Plan of Urban Development', which was approved by the City Council in 2001 (Sagredo, 2020).

Aiming to enhance innovation, the Plan 22@ proposed the specialization of the district in 5 different knowledge areas in which the city would reach a global leadership position by creating excellence clusters: ICT, Bio-Med, Design, Energy, and Media (Sagredo, 2020).

Leadership and Governance

Initially, the area was managed by 22 ARROBA BCN SA, a real estate company created by the Barcelona City Council in the 2000.

After years of development, the City Council began a participatory reflection process with all the actors of the district (agents of the quadruple helix: citizens, economic sector, universities and public administrations), aiming to define a shared roadmap to continue transformation of the area. More than 1,000 people from different organizations and sectors took part in the "Repensem 22@" process (Barcelona City Council, 2021b).

The new plan was approved by the city council in November 2020, and the 22@ Technical Office (which is now responsible for the governance, promotion and coordination of the projects at 22@) was inaugurated. The office is physically integrated with the Business Support Office operated by Barcelona Activa (Barcelona City Council, 2020).

Physical Space

The 22@ innovation district is located on a little over 200 hectares of what used to be industrial sites (Barcelona City Council, 2020a). An eclectic mix of restored industrial buildings and new, modern establishments constitutes the district. Among them, we could highlight the Torre Agbar (designed by the architect Jean Nouvel); the Barcelona Growth Centre building, which has received the highest awards for energy efficiency, sustainability, and design; and the Disseny Hub Barcelona (Barcelona City Council, 2020a).

A total of 114 buildings that were part of Poblenou's special industrial heritage plan have been redesigned to achieve greater sustainability, becoming historical landmark buildings. Examples are the Casal Taulat Can Saladrigas, or the Can Framis Museum of the Vila Casas Foundation, an 18th century textile factory which in 2009 became a Museum of Contemporary Painting (El País, 2020).

Moreover, the Smart City Campus, an initiative of the City Council in collaboration with several firms of the district, is located at the 22@ innovation district. Prestigious hotels such as the Hilton, restaurants, and the Diagonal Mar shopping Centre offer advanced technological solutions to their clients. The district also includes public spaces such as Parque Central de Poblenou and Parc Diagonal Mar (El País, 2020).

The initial plan for 22@ proposed that 90% of the land would be for offices and hotels, and just 10% was for housing. However, the renovated strategy aims to rebalance the percentage of land-use, proposing a 70-30 ratio. Moreover, all the new dwellings will be state-subsidized (Público, 2020).

With respect to its accessibility, the district is near the city Centre (35 minutes walking and 12-20 by car or public transportation). 22@ is accessible by various transit lines, including Metro-L1, Trains -R1, -R2. R2N and four bus routes (Sagredo, 2020).

Main Actors

22@ hosts more than 1,500 companies, including new start-ups, business accelerators, venture capital and large companies such as Yahoo! R&D, Facebook, Amazon, Ebay, Microsoft, Schneider Electric Indra, Cisco Systems, T-Systems, or Mediapro (El País, 2020).

The Media-TIC building, whose facade takes advantage of the sun and the wind to capture energy, is an icon of environmental sustainability and technological innovation at the heart of the 22@ district. The building includes an incubator and hosts the BCN Growth Centre, a resource centre for fostering business, job creation and attracting talent and investments (Barcelona City Council, 2014).

Other Centres for technology transfer and R&D can be found in the district, such as the ones of Orange, Telefónica, Alstom, Leitat, KimBCN, and Barcelona Activa (Barcelona Treball, 2021) (Barcelona Treball, 2021).

Finally, several educational institutions have buildings in the area, including the Pompeu Fabra University (UPF) (Welcome to Barcelona, 2021). UPF is the 1st Spanish university (position 152 worldwide and 65 in Europe), as well as the 10th highest ranked university in the world among those under 50 years of age by the Times Higher Education ranking (2020-2021) (UPF, 2021b).

Innovation And Collaboration

The 22@ was presented in 2018 to the United Nations International Public-Private Partnership Forum with the title "Scaling up: Meeting the challenges of the United Nations 2030 Agenda for sustainable development through the people-first public-private partnerships" (Ajuntament of Barcelona, 2018).

This proposal reflects the spirit of the district since its beginning in the 2000s, when the innovation district promoted the creation of public-private partnerships (PPP) and started attracting firms and universities. The synergies created by the co-location of firms and institutions from a variety of sectors in the area, and the efforts of the agents to promote knowledge-exchange and collaboration among the agents of the district.

The UPF, which shares multiple spaces with innovative firms in the district, was ranked 84 in the world in the Leiden ranking (2020) of articles published in the most influential journals, and it is the 1st Spanish university in percentage of articles published in the most influential scholarly journals, 1st Spanish university in percentage of papers produced in collaboration with national institutions and 2nd Spanish university in percentage of papers produced in collaboration with foreign institutions (See Annex 1) (UPF, 2021a).

Parc Científic de Barcelona (PCB)

The PCB was built by the University of Barcelona in 1997, becoming the first science Park in Spain. It is focused on key areas of the health sector, such as nano- and bio-technology, pharmacology, medical devices, as well as food and cosmetics technology (PCB, 2021d).

Leadership-Governance

The PCB is managed by the Barcelona Science Park Foundation, a private legal entity made up of five institutions: the University of Barcelona (UB), Bosch i Gimpera Foundation (created by the UB for the transfer and commercialization of the park technological developments), the bank Caixa Catalunya, the Education Department of the Autonomous Government of Catalonia, and the Spanish

Council for Scientific Research (CSIC) (European Commission, 2007). The board of the foundation cooperates with a scientific committee, which offers guidance and counsel, and assesses and monitors the research projects conducted in the park (European Commission, 2007).

The mission of the PCB is to promote research, knowledge transfer and innovation in the public and private sectors through intelligent space management, technology availability and collaboration with the PCB community (PCB, 2021d).

Physical Space

The park is located in the Les Corts District, a very attractive area which offers a combination of cultural and architectural heritage, including museums, natural spaces, and recreational facilities, among others.

Specifically, the PCB is located in the Southern part of the Barcelona Knowledge Campus, an area composed by the campuses of the Universidad de Barcelona and the Universidad Politécnica de Cataluña (UPC) which has been recognized as a campus of international excellence because of the quality of their institutions and the physical space in which they are located (BKC, 2021a). BKC is home to twenty-three research centres, over 200 start-ups, 47 spin-offs (nine of them affiliates), as well as faculty buildings, and connects the Barcelona Science Park (PCB) and the technology park of the UPC (BKC, 2021b).

The science park comprises 7 buildings, and the more than 100,000m2 built include more than 22,000m2 of laboratories, and about 5,000 m2 of facilities dedicated to scientific services (PCB, 2021d). Inside the Park, there are two restaurants, three outside areas, 15 meeting rooms, and three conference rooms (PCB, 2021d).

The Park can be accessed by tram (routes T1, T2 and T3), metro (line 3), bus, and by bike. Moreover, the Scientific Park owns a car park equipped with the latest technology (charging posts for electric cars and motorbikes, WIFI services…) (IRB Barcelona, 2021).

Main Actors

Anchored the UB (one of the top public universities in Spain which ranked #183 in QS Global World Rankings 2021), the Park community comprises more than 3,000 professionals and brings together research centres and firms.

The park hosts six cutting-edge public research centres, including the Institute of Molecular Biology of Barcelona (IBMB-CSIC) and the Institute of Biomedical Research of Barcelona (IRB Barcelona) (PCB, 2021b).

Additionally, more than 100 businesses, including pharmaceutical, biotechnological and nutrition companies, SMEs, start-ups, spin-offs, etc. (PCB, 2021d). Some examples of multinational companies installed at the PCB are Merck, Laboratories Esteve and Almirall (PCB, 2021d).

Moreover, there are two incubators in the park: the CIDEM-PCB Bioincubator (CIDEM is the Centre for Business Development and Innovation of Catalonia), which hosts and promotes five companies in the biotechnology sector, and the PCB-Santander Bioincubator, which can host up to 15 companies (PCB, 2008).

PCB offers access to various research facilities, including the National Centre for Genomic Analysis (CNAG), the radioactive installation, the Applied Research Platform in Laboratory Animals (PRAAL), the Toxicology and Ecotoxicology Unit, and the Proteomics Platform (Xpcat, 2021).

Innovation and Collaboration

PCB supports business development through a variety of events, networking activities, and advisory services on topics such as patents and intellectual property (Xpcat, 2021). Moreover, the PCB

Foundation promotes the creation of partnerships between the laboratories and firms installed at the park and cooperates with other European Science Parks (European Commission, 2007).

The convergence of private firms and researchers from both private laboratories and public groups work in the same location and are sharing the same scientific equipment that enables synergies to arise (joint ventures, mixed scientific projects, mixed laboratories etc.) and makes the PCB a pioneering reference on a national level in the promotion of technology transfer (European Commission, 2007). Moreover, the UB has the fifth largest share of publications in the top 10% in Spain (See Annex 2).

Since 2002, PCB has worked to promote a critical and scientific way of thinking of the citizens of Barcelona. With this objective in mind, the PCB has created spaces of coexistence between researchers and the neighbours of the park. Nowadays, the PCB organizes more than 200 activities and experiment workshops annually, and the sum of annual participants exceeds 6,000 (PCB, 2021c).

3.2.4. PARC UPC

The technology park of the Universitat Politècnica de Catalunya (UPC) was inaugurated in the year 2005. Its priority areas of action are ICT, robotics, nanotechnology, biomedical engineering, energy, materials engineering, among others (APTE, 2021).

Leadership

The park is managed by the UPC and has the support of Barcelona City Council through its local development agency, Barcelona Activa. Banco Santander also contributes to the development of its activity.

The UPC Park's main objectives are (i) to create an innovation ecosystem by providing infrastructures and services to companies based on technology; and (ii) to promote the social commitment of the UPC with research, innovation, the transfer of results, and scientific and technological progress (UPC, 2021d). At the park, the Centre for Innovation and Technology (CIT-UPC) promotes businesses' competitiveness through the development and application of the knowledge generated in the R&D Centres of the UPC (AMB, 2021).

Physical Space

The UPC technology park is located in the Northern part of the Barcelona Knowledge Campus (BKC, 2021a). The North Campus is home to several colleges of the UPC, university services such as a library, a sports centre, a shopping area, and the Pedralbes Palace Gardens (Roca, 2011; UPC, 2021a).

The same public transport stations mentioned for the PCB are used to access the Parc UPC. Moreover, the Interparking UPC Campus Nord is available for members of the university community.

Main Actors

UPC is a public institution for research and higher education in the fields of engineering, architecture, science and technology, and is one of the leading polytechnic universities in Europe. In the 2021 edition, the UPC ranked 20th in the world in Architecture, and 29th in Civil and Structural Engineering. It is also among the world's top 100 universities in other engineering fields (UPC, 2021e). The North Campus is home to the Faculty of Informatics, and the Schools of Civil and Telecommunications Engineering, as well as several research Centres.

The Campus also hosts the Barcelona Supercomputing Centre (BSC), which was created in 2005 as a consortium formed by the Spanish Ministry of Economy, Industry and Competitiveness (60%), the

Catalan Government Department of Enterprise and Knowledge (30%) and the Polytechnic University of Catalonia (UPC) (10%), and is one of the most powerful of Europe (UPC, 2021c; Roca, 2011).

The UPC Park is composed of three buildings: K2M (destined to locate university-company projects), Nexus I and Nexus II buildings (occupied by companies in the technology sector and R&D departments) (APTE, 2021).

UPC Park provides incubation services and supports entrepreneurs through several platforms such as CIM-UPC, an innovation and technology centre that specialises in Additional Manufacturing which offers technological services and specific training programmes (AMB, 2021; UPC, 2021f).

Innovation and Collaboration

Through Parc UPC, the UPC generates knowledge and transfers it to different businesses. In addition to this kind of collaboration, which is often international in scope, the UPC also supports SMEs that want to innovate. These activities are coordinated by CIT-UPC, the Centre for Innovation and Technology of the UPC (AMB, 2021; CIT-UPC, 2021).

The UPC has agreements with more than 2,600 organizations, has founded a total of 14 companies, and in 2020 registered 15 patents and started 654 research projects (UPC, 2021b). It has the largest share of open access publications in Spain. Its strategic location allows it to collaborate with nearby institutions, which is demonstrated by the fact that 17.3 % of their publications are co-authored with institutions located at less than 100 km (see Annex 1).

3.3.Amsterdam (The Netherlands)

Amsterdam is the capital and most populous city of the Netherlands with a total of over 2.4 million inhabitants in its metropolitan area (Iamsterdam, 2021b). The city offers a highly cooperative environment, driven by the concentration of its many research institutions, universities, corporations, and start-ups (Iamsterdam, 2021a).

In 2016, the European Commission awarded the title of European Capital of Innovation ("iCapital") to Amsterdam. The city proposed a holistic vision of innovation, structured on the basis of four pillars of urban life: government, economy, social inclusion, and quality of life (European Commission, 2016).

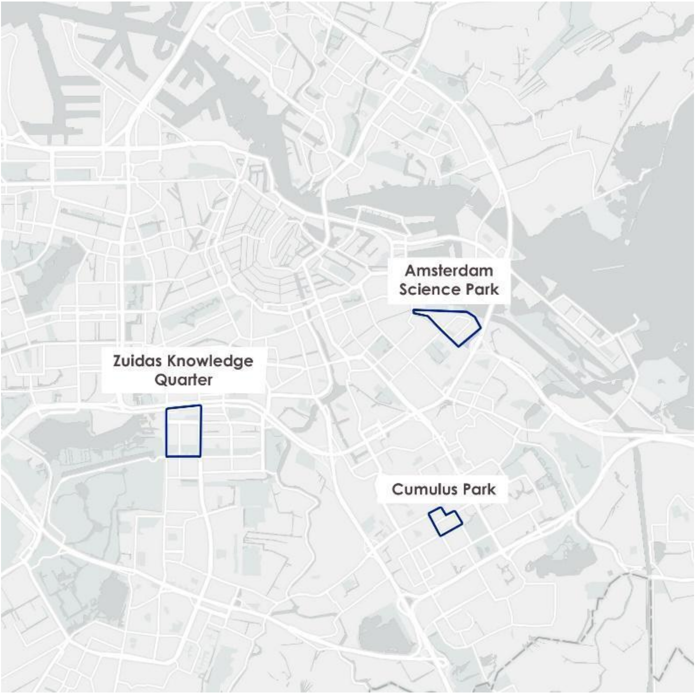
Amsterdam is a leader on urban mobility, and it is succeeding in the challenge of shifting people out of cars towards public transport, walking and cycling through smart mobility solutions (Amsterdam, 2021b). The city is also a global reference in life sciences and advanced technology.

A series of initiatives support Amsterdam's innovation strategy, including the Smart City initiative (a living laboratory for product testing); or Start-up Amsterdam, a public-private partnership that aims to set the city as a point of reference in the European entrepreneurship landscape (Dynamic, 2020).

Furthermore, the Dutch capital has a generous tax regime, which has attracted large international tech companies such as Uber, Netflix, or Tesla (Dynamic, 2020). This and other reasons have positioned Amsterdam as a top business hub (Financial Times, 2021).

Amsterdam has three geographies of innovation, all of them within 44.5 km2: Amsterdam Science Park, the Zuidas Knowledge Quarter, and Cumulus Park.

Figure 3 *Geographies of innovation in Amsterdam*



Source: Own Elaboration

3.3.1. Amsterdam Science Park

Amsterdam Science Park is home to one of the largest concentrations of beta sciences in Europe. Its strategic areas of specialization are life sciences, advanced instrumentation, and ICT (Amsterdam, 2021a). The Park is a collaborative initiative of the University of Amsterdam, the municipality of Amsterdam and the Netherlands Organization for Scientific Research (NWO), and was designated by the municipality as a metropolitan project in 1996, although the actual start took place in 2006 (Gebiedsontwikkeling, 2012).

Leadership and Government

The land is mostly owned by the University of Amsterdam (UvA) and the municipality, which leases it out to builders and developers. The NWO owns the western part (Gebiedsontwikkeling, 2012). These three institutions together drafted the Amsterdam Science Park Development Vision, which studies strategies to strengthen physical and social connections, as well as the thematic programming of the Park. This document complements the municipal Master Plan, whose main focus are spatial aspects.

The Park mission is to stimulate a culture of innovation and develop knowledge with a positive economic and social impact. They aim to do so through the promotion of application-oriented activities in education and research, and by actively connecting students and researchers with start-ups and big companies (Amsterdam, 2019).

Physical Space

Amsterdam Science Park is located in the Watergraafsmeer district, just six kilometres east of the city centre. It spans 80 hectares, in which the buildings are shaded by trees and greenery. Several restaurants and catering facilities, as well as the Universum Sports Centre and a variety of meeting facilities are available at the park, which will be further developed until 2029 (Amsterdam, 2021a).

More housing options will be added to create a lively urban area. The housing programme comprises student residences with mixed priced units, and private sector rental apartments. There are also plans for a hotel with conference and meeting facilities (Amsterdam, 2021a; Amsterdam Science Park, 2020 and Gebiedsontwikkeling, 2012).

Accessibility has been improving throughout the years. In 2009, the Science Park railway station was inaugurated, connecting it with Amsterdam Central Station via an eight-minute train ride and with Schipol Airport in less than 30 minutes. Car accesses have also improved, adding paid parking spaces at several locations of the Science Park. Moreover, bicycle connections have been established (Amsterdam, 2021a and Amsterdam Science Park, 2020).

Main Actors

The park houses the following leading research institutes: AMOLF (Physics of Biomolecular systems and Nano-photonics), Advanced Research Centre for Nanolithography (ARCNL), National Research Institute for Mathematics and Computer Science (CWI), National Institute for Subatomic Physics (NIKHEF), EGI.eu, the coordinating organization for the European Grid Infrastructure, and SURFsara, the Dutch National High Performance Computing centre (Amsterdam Science Park, 2020).

Moreover, Amsterdam Science Park is home to eight research institutes of the University of Amsterdam (a top 100 university in the QS Ranking), and its Faculty of Science, as well as the Amsterdam University College campus (Amsterdam Science Park, 2020, Gebiedsontwikkeling, 2012 and University of Amsterdam, 2020b).

The Park hosts more than 600 network hubs, including the largest data transport hub in the world, the AMS-IX, and offers cutting-edge lab facilities for Bioinformatics, Biotechnology, Genome technology, among other fields (Amsterdam, 2021a and Amsterdam Science Park, 2021).

ASP is home to 60 science and deep-tech start-ups and spin-offs, as well as to more than 100 knowledge-intensive SMEs, and 10 multinational companies, including Fokker Aerostructures, Tata Steel, Qualcomm, Agendia, Kite Pharma, Nikon Instruments, ASML, or Digital Reality (Amsterdam Science Park, 2020).

Many start-ups are powered by accelerators and incubators based in the park. The biggest one is the Start-up Village, a community working space which houses around 30 start-ups with a science or tech focus (ACE, 2021 and Amsterdam Venture Studios, 2021a).

Small companies are located in five multi-tenant buildings (the sixth is under construction), exploited by the Matrix Innovation Centre. The Matrix I building, whose construction will finish in 2022, will host the Open Kitchen Lab, a laboratory facility already provided with the basic equipment and consumables, whose spaces will be available for start-ups, with rental periods that can vary from days to months (Matrix Innovation Centre, 2021 and University of Amsterdam, 2020a).

Innovation and Collaboration

Amsterdam Science Park has the Netherlands' highest concentration of publicly funded research. Through the organization of networking events and co-creation sessions, the Park offers multiple opportunities for students, researchers and businesses to collaborate.

Moreover, Innovation Exchange Amsterdam (IXA), which is the joint knowledge transfer office of the Amsterdam universities and medical centres, supports researchers in creating value from their knowledge and expertise (Amsterdam, 2021a).

As a result, countless public-private R&D programmes take place across numerous disciplines. The UvA is the second Dutch university in scientific impact and has the third largest share of co-publications in the Netherlands (University of Amsterdam, 2020b) (see Annex 1).

3.3.2. Zuidas Knowledge Quarter

The Knowledge Quarter (Kenniskwartier) is one of 12 sub-areas in which Zuidas, Amsterdam's legal and finance district, is located. Kenniskwartier, which is still under development, will connect the VU University and the VUmc Academic Hospital with the businesses and the other functions of Zuidas.

With such a combination of actors (R&D institutions, new start-ups, and talent) in an area that is being specifically designed to enhance collaboration and innovation, the Knowledge Quarter has a strong potential to become a powerful innovation district.

Leadership and Governance

The Amsterdam Zuidas Company was created in 2004 by the municipality of Amsterdam and the National Government, with the purpose of coordinating the development of the Zuidas area. In addition to both governments, private companies were selected to participate in the design process for Zuidas (Zuidas, 2016a; Zuidas, 2016b).

For this project, Zuidas and the two academic institutions (VU University and VUmc Academic Hospital) joined forces, aiming to create an inspiring place where education, research, patient care and industry come together and reinforce each other (Issuu, 2014; VU, 2014; Zuidas, 2018a).

Physical Space

The Knowledge Quarter is being developed in the southwestern part of Zuidas, a neighbourhood which already offers outstanding recreational facilities and fine shops. Partly thanks to the presence of international companies, Zuidas has its own cosmopolitan character (Invest in Amsterdam, 2018).

The Kenniskwartier area is known primarily as the location of the Academic Hospital and the University, whose campus has excellent educational and research facilities, as well as a Sports Centre, catering establishments, and a theatre. Sustainability is reflected in flexible and open buildings, car-free areas and green spaces (VU, 2021a).

The 44 hectares of the Knowledge Quarter will host modern architecture buildings and public spaces, creating an attractive environment. In addition to high-quality amenities, hotels, art and culture, Kenniskwartier will offer 1200 student housing units, as well as 600 apartments for families and singles. Some of these will be subsidized by the municipal government. (Zuidas, 2016b), (Calcmaps, 2021; Invest in Amsterdam, 2018; The Global Institute on Innovation Districts, 2019).

The first part to be developed will be the northern one, in which the Edge, one of the world's most sustainable and smartest office buildings, is located. Right next to this area, a shared space for pedestrians and cyclists named the Diagonal will be built (Bloomberg, 2015), (Zuidas, 2018b).

The Knowledge Quarter is connected to other parts of the city by railway, metro, buses and tram. It is a 15 minutes cycling distance to the centre of Amsterdam. Moreover, the most ambitious project in Zuidas (the Zuidasdok, which includes a partial underground installation of the A10 South motorway) will provide Amsterdam-Zuid Station the possibility to grow into a high-quality public transportation hub (Fluor, 2017; Zuidas, 2016b).

Main Actors

The principal actors in the area are the Vrije Universiteit Amsterdam (VU) and the University Medical Centre, as well as the Academic Centre for Dentistry Amsterdam (ACTA) and the Inholland University of Applied Sciences.

VU is primarily focused in 4 areas, including Human Health and Life Sciences, Sustainability, ICT, and the business and finance sector. In 2019, VU had 46 bachelor's programs and 98 master's programs and was the 236th in the QS World University Rankings (QS Top Universities, 2021).

With research institutes like the Cancer Centre Amsterdam and Amsterdam Neuroscience, and its proximity to the European Medicines Agency (EMA), the area is a global leader for scientific research in oncology and neurology (I Amsterdam, 2021c).

Cooperation between science, start-ups and the business community is supported by several intermediaries: Innovation Exchange Amsterdam (a transfer knowledge office), the ACE incubator, the Demonstrator Lab, Amsterdam Venture Studios (a community workspace for start-ups). In late

2021, the VU StartHub will start offering programmes for students who are starting businesses with social impact (Amsterdam Venture Studios, 2021b; VU, 2021b).

Some multinational companies such as the professional services firm Deloitte have already moved its offices to the Knowledge Quarter, and multi-tenant buildings, such as NoMA House, are being built (The Office Operators, 2021).

Innovation and Collaboration

At the Knowledge Quarter, a broad spectrum of science is available in terms of both teaching and research. Many interdisciplinary research institutes have been established in the area: the Network Institute, the Tinbergen Institute, Laserlab Amsterdam and Amsterdam Public Health (APH). These institutions are collaborating on pioneering research with societal impact (VU, 2021b).

Located in this innovative environment, VU is an open university, with the largest national share of publications (90%) with co-authors from outside the university and the second national share of publications with partners in a radius smaller than 100km, which reflect the collaborative environment that is being created at the Knowledge Quarter (See Annex 2).

3.3.3. Cumulus Park

Cumulus Park's design phase started in 2018, so it is still in the early stages of development. The objective is to build an innovation district focused on urbanization and digital identity put in practice through topics such as mobility, e-commerce and retail, construction, smart city (Cumulus Park, 2021; Karres en Brands, 2021).

Leadership and Governance

The objective of Cumulus Park is to become a space where small and large businesses, researchers, entrepreneurs and students can work together on solutions for contemporary urban and social challenges. In addition, it aims to position Amsterdam as a city of collaborative innovation, and attract the finest talents from all over the world (Iamsterdam, 2019; ING, 2019).

The project is being developed by four actors, which represent all the components of the Triple Helix model of Innovation (industry-government-university): ING, the City of Amsterdam, ROC Amsterdam, and the Amsterdam University of Applied Sciences (HvA) (Amsterdam University of Applied Sciences, 2019).

Physical Space

Cumulus Park, with a size of about 20 hectares, is being built in Amsterdam-Zuidoost, an exclave of Amsterdam in the city's south southeast (Karres en Brands, 2021).

The spatial vision put forth by Karres en Brands, the agency responsible for the design of the Park, is based around a simple and clear concept: collaboration centred around public space. Thus, Cumulus Park will have interconnected buildings and an inspiring mix of green meeting spaces, open offices, sport facilities, labs, lecture halls, shops, bars and restaurants (Amsterdam University of Applied Sciences, 2019; Karres en Brands, 2021).

The Park is well connected and easily accessible by car, bicycle and public transport. Located just 10 minutes walking distance from Amsterdam Bijlmer Arena metro station, from where it is connected to Amsterdam Central Station and Schiphol Airport (Cumulus Park, 2021).

Actors, Innovation and Collaboration

Many organizations from the Network Council of the Amsterdam Economic Board are involved in the development of the district, an idea that arose at ING. The list includes Delft University of Technology and Plug and Play Tech Centre (a large Silicon Valley accelerator) (Amsterdam Economic Board, 2020).

The Amsterdam University of Applied Sciences (HvA) also has some facilities in the area.

Research at HvA is geared towards solving practical problems in the fields of urban management, technology and vitality, as well as creative industries (Times Higher Education, 2018).

At the Park, the ING incubator Cumulus Park Studio offers spaces, events and programs to enhance networking and innovation and to attract talent across a huge range of disciplines. In the coming period, various activities and events will kick-off in Cumulus Park, such as a platform for local entrepreneurs, knowledge sessions and meet-ups (Amsterdam University of Applied Sciences, 2019; ING, 2019).

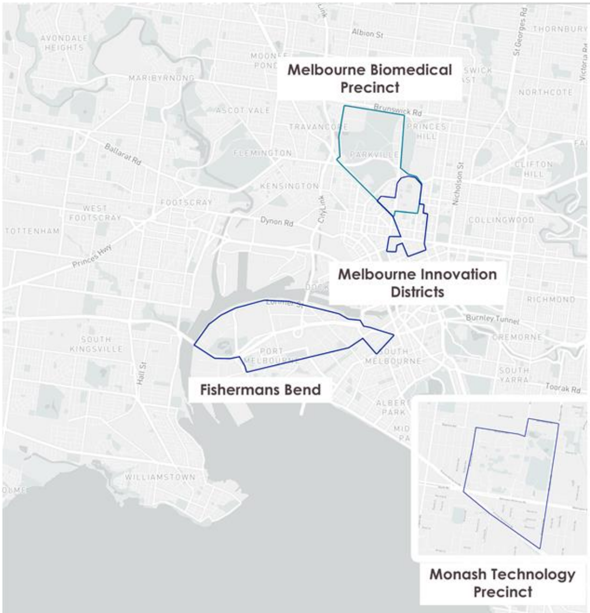
3.4.Melbourne (Australia)

Capital of the State of Victoria and the second largest city in Australia, (Greater) Melbourne is approximately 9900 km^2 and it is considered in the top ten of most liveable cities in the world according to the Economist Intelligence Unit (2021). Melbourne is the 10^{th} best city in the world for talent concentration and second in Asia Pacific, only after Sydney (JLL, 2019). It is well-known for being Australia's cultural and knowledge city, with a strong knowledge economy that significantly contributes to the city's economy through sectors such as advanced manufacturing, biotechnology, creative and design industries, education, financial and professional services, health, ICT, research and science (City of Melbourne, 2021a).

Together with advanced businesses, Melbourne has quality knowledge infrastructures, research and training excellence, a highly skilled workforce, and a strong networking culture, which makes Melbourne a city with good conditions for innovation, entrepreneurship and knowledge transfer (City of Melbourne, 2021a).

Melbourne has a series of geographies of innovation and this report highlights the three main ones. Melbourne Innovation Districts (that includes Melbourne Biomedical Precinct), Fishermans Bend and Monash Technology Precinct and Employment Cluster.

Figure 4 Melbourne Geographies of Innovation



Source: Own Elaboration

3.4.1. Melbourne innovation districts

In 2018, the Melbourne Innovation Districts (MID) was founded in the centre of Melbourne around five essential components of future cities: digitally enabled technologies, Enterprise Activation. Institutional Design, Public Realm and Social Innovation (MID, 2021a).

Leadership and governance

MID is a partnership between the City of Melbourne, RMIT University, and the University of Melbourne, in order to benefit the whole city through the development of urban innovations (MID, 2021a).

The Melbourne Innovation Districts Urban Realm Action Plan for City North developed the concept, and with this base, the Future Melbourne Committee, made a public consultation and later presented the strategy to operate and create Melbourne Innovation Districts (City of Melbourne, 2021b). The mission is to 'support urban innovation in Melbourne for the benefit of the whole city' (MID, 2021a).

These districts are very inclusive and aim to bring together researchers, knowledge workers, students, businesses, start-ups and the community by connecting their ideas and activities, and eventually creating long-term partnerships. This is done through a strong joint programme of work that involves all stakeholders within the districts and currently includes over 30 joint projects. The leadership also sees the innovation districts as a place where innovations and prototypes can be tested in the early stages of development (MID, 2021a).

Physical space

The area where MID is located includes the northern fringes of Melbourne's central business district and parts of Parkville and Carlton, that is why this area is also referred as MID City North (City of Melbourne, 2020).

In 1853, the University of Melbourne was established in that area together with adjacent hospitals and the first technical college starting to create a knowledge area in the city (City of Melbourne, 2020). Since that moment on, cultural institutions, knowledge companies and high technology companies have established themselves in the area.

The district houses the central campuses of the University of Melbourne and RMIT University. It is also home to several research centres such as the Bio21 Institute, Howard Florey Institute, and the Centre Neural Engineering (City of Melbourne, 2020). The area is still under redesign and the main investments in redesign of spaces include the following (MID, 2021a):

- *Queen Victoria Market redevelopment* - Possessing 43 years of history, it houses more than 600 small and mostly traditional businesses , making it one the world's largest open-shed market. Its redevelopment considers the construction of the Community Hub in Munro, which will integrate childcare, a community kitchen, community services, meeting spaces and affordable housing, as well as hotels, apartments, retail and hospitality facilities.
- *University Square* – Comprising 8739 squares of public open space by closing roads. This green area interconnects University of Melbourne campus with the broader society, aiming to become a living lab through the re use of stormwater and the capture of solar energy.
- *New Academic Street* - After two years of construction, the RMIT Central Campus was transformed into an interconnected and vibrant space. Its human centric design won the Melbourne Design Award in 2018.
- *Redevelopment of the former Royal Women's Hospital* - Led by the University of Melbourne, the facilities will include retail, indoor and outdoor public spaces, student accommodation, offices, and the Science Gallery Melbourne.

These actions have increased the already high walkability and green spaces inside the districts. This attractive area with porous buildings and is hyper connected with several lines of bus, tram, train and metro to the rest of the city and greater Melbourne.

Main Actors

MID is anchored by two leading universities. The University of Melbourne is one of Australia's top universities, and it is ranked among the top 50 universities worldwide (Times Higher Education, Ranking, 2021) RMIT University is one of Australia's leading technical universities and ranks 18th among the world's top universities under 50 years old according to the QS Rankings 2021. It also offers vocational education and apprenticeships (RMIT University, 2021). These universities own some spaces that are key parts of MID, such as the Social Innovation Hub, a co-working space of RMIT.

MID is composed of 30 major players including large companies such as IBM and Microsoft. Both companies have industrial research centres, IBM's being the largest in Australia (MID, 2021a). Its main areas of development are software engineering, artificial intelligence, blockchain and Internet of Things.

MID includes some smaller highly specialised areas, including the Parkville Medical Precinct. Australia's biomedical research hub hosts world-class hospitals, medical research institutes, biomedical organizations and universities (Victoria State Government, 2021a). It includes the Royal Women's Hospital, Australia's first public women's hospital and one of the most well-known women's hospitals worldwide (The Royal Women's Hospital, 2021).

An additional precinct is Melbourne Connect, the University of Melbourne's flagship innovation precinct that incorporates space for the University's Engineering School, co-location of industry, and start-up incubator and accelerator spaces (Melbourne Connect, 2021).

The districts also have a vibrant start-up community as well as a large offer of restaurants, cafeterias and shops that increases the attractiveness and dynamism of MID. It is a highly sought-after area in the city that keeps attracting innovative players.

Innovation and collaboration

Most of the actors within MID are highly innovative organizations and MID concentrates 21% of all knowledge sector jobs in Melbourne (City of Melbourne, 2021b). The variety of the stakeholders in MID allows for a wide variety of dynamics and ideas. The University of Melbourne and RMIT publish high quality papers and over 85% of the papers have been in collaboration with other organizations, although only 4 or 5% are with industry partners (see Annex 2).

Most organizations located in MID take advantage of their location to establish and strengthen synergistic relationships with other stakeholders in MID, which continues the development of a network with organizations and people that aim to collaborate, particularly around the five key areas.

MID sponsors programmes that encourage innovation among their stakeholders, whether these programmes are internal or external (e.g. Impact 7 2020, to find solutions for Australia's seven greatest challenges). Additionally, it participates in programmes that help MID develop, such as Melbourne Knowledge Week, a city annual open event in which MID management and the actors within MID have an active role and discuss about the activities and potential of the districts within the city´s Knowledge Strategy (MID, 2021b).

The collaboration with the city also comes through city funding of MID activities. Organizations in MID often apply for city funding, as much of it is aligned with their priorities or lines of work (e.g. the Waste Minimisation and Innovation Fund 2019, as part of the city waste management strategy).

3.4.2. Monash national employment and innovation cluster

The Monash National Employment and Innovation Cluster (Monash NEIC) is a large agglomeration of health, education, technology, employment, and industrial activities identified within Plan Melbourne, a city planning strategy that defines the future of Melbourne and Victoria over the next 35 years. It is part of the policy initiative Victoria's Priority Precincts and National Employment and Innovation Clusters, and it is still under development (VPA, 2017).

Leadership and governance

A multidisciplinary team within the state government of Victoria is behind the Monash NEIC initiative, which is established as an umbrella term to increase the collaboration of a series of already existing smaller geographies of innovation that are themselves in transformation around the City of Monash, City of Kingston and City of Greater Dandenong (VPA, 2021). This cluster is made of five precincts (VPA, 2016):

- *The Health and Education Precinct:* led by Monash University in close collaboration with Monash Medical Centre
- *The Monash Technology Precinct*: led by Monash University and the energy company Engie, with engagement of the Victorian Government Department of Jobs, Precinct and Regions and Sustainability Victoria.
- The Huntingdale industrial Precinct: led by the City of Monash.
- The Clayton/Springvale Employment Precinct: led by the city of Greater Dandenong.
- The Clayton South Industrial Precinct: led by the city of Kingston.

The ultimate aim of Monash NEIC is to transform and modernise to become a "connected and exciting place for employment, education, innovation, leading-edge technology, and research" (VPA, 2021). The responsible team coordinates place-based policy, planning, design, investment, and delivery of Monash NEIC across government agencies, with Monash University and Medical Centre as well as with the local governments driving three of the precincts.

Physical space

The Monash Cluster is located 20km south-east of central Melbourne. It includes the cities of Monash, Greater Dandenong and Kingston, and it takes several business and industrial areas around seven different suburbs. The aim from an urban point of view is to convert underutilised industrial land with obsolete buildings into easily accessible residential areas.

Monash NEIC includes universities, research centres, industrial areas, commercial areas and some housing. The development plan aims to improve the current infrastructure and increase walkability, to link all the precincts better with each other (e.g. by removing level crossings) and with the centre of Melbourne and other areas in greater Melbourne, by opening new train stations and creating a road to directly connect with the freeway. Also, the plan aims to increase green spaces in the cluster. The main current characteristics and the specific plans to improve each of the precincts are (VPA, 2016):

- *The Health, Education and Research Precinct:* the education and research area will increase in education activities, include the Victorian Heart Hospital and build new accommodation
- *The Monash Technology Precinct:* presently an area of technology business that will encourage business diversification and employment growth through improved transport connections
- *The Huntingdale industrial Precinct:* the current industrial area will increase access to services and facilities and improve public spaces
- *The Clayton/Springvale Employment Precinct:* the popular and vibrant multicultural retail and commercial centre will improve housing choices and business opportunities.
- *The Clayton South Industrial Precinct:* the current industrial area will continue to support industry that fosters innovation, growth, and employment diversification

Main Actors

Each of the five precincts have their own anchor institutions based on their current characteristics. However, when Monash NEIC is completed, these will be the main anchors of the large cluster (Invest Victoria, 2021).

Monash University, established in Melbourne in 1958, is one of Australia's leading universities and ranks among the world's top 100 according to the Academic Ranking of World Universities.

Monash Medical Centre, a comprehensive research and teaching hospital, and research clinics such as BrainPark.

CSIRO, the National Science Research Agency of Australia.

Australian Synchrotron, one of Australia's most significant pieces of scientific infrastructure.

Research Centres such as Hudson Institute of Medical Research, the Australian Regenerative Medicine Institute, the ARC Centre of Excellence for Integrative Brain Function.

Some large and/or innovative business such as Xenon Systems, Weir Minerals, Leidos Australia, Lockheed Martin, Auschem Pacific Group, BASF, PPG Industries, Dulux Group, VISY, Grifos Australia, Axtent Global, Goodman Fielder, McCormic Food Australia, Maltra Foods, etc.

Innovation and collaboration

Monash University has the largest share of high impact publications in Australia and 87% of them are co-authored with externals and 4.5% with industry (see Annex 2). The research centres in the cluster also count for a large part of the innovation activities, as well as some innovative companies in the technology precinct. However, the more industrial, residential and commercial areas are less innovative. Innovation is planned to increase in those precincts that are currently focused on more traditional industries or in commercial sectors.

Today, some collaboration exists between the university, medical centre and research centres in the Health, Education and Research Precinct and to some extent between the companies in the Monash Technology Precinct, but there is no evidence of present collaboration between organizations in different precincts. This will be encouraged when they are all formally part of Monash NEIC.

3.4.3. Fishermans Bend

Currently an industrial area with some big players, Fishermans Bend will become a well-connected innovation district with representation of two universities, commercial, residential and green areas led by the Victorian State Government (Victoria State Government, 2016).

Leadership and governance

Fishermans Bend is an initiative of the State Government of Victoria. A Development Board of experts and community representatives chaired by a public administration representative is leading its planning and development, guiding the engagement with the community and advising on precinct plans and major decisions. The process started in 2012 with its rezone to Capital City Zone and a public consultation but it is planned to last for another 30 years. Fishermans Bend is a key part of Plan Melbourne, the long-term strategy for Metropolitan Melbourne (Victoria State Government, 2016).

The vision for 2050 is to become "a thriving place that is a leading example for environmental sustainability, liveability, connectivity, diversity and innovation".

Physical space

The plan of Fishermans Bend covers approximately 480 hectares in the heart of Melbourne, which become Australia's largest urban renewal project. Currently, Fishermans Bend is made up of five precincts across two municipalities (the City of Melbourne and the City of Port Phillip) (Victoria State Government, 2021b):

- Lorimer: a vibrant, mixed-use precinct close to the river and well-connected
- Montague: a diverse and well-connected mixed-used precinct with gritty streets and laneways
- Wirraway: a family friendly inner-city neighbourhood close to the bay
- Sandridge: a Melbourne's premium office and commercial centre, with housing and retail
- Employment Precinct: Australia's leading design, engineering and advanced manufacturing precinct

However, this area is not well connected with public transport and have few green spaces. To these precincts, some the plans are to double open spaces and connect them with walking and cycling paths; build four primary and a secondary school and multi-purpose health, arts, sports and community hubs; increase and diversify the residential area, including social housing and 6% affordable housing; build a tram network and metro rail connection, offer high speed connectivity across the area and create activity centre in each precinct including retail, jobs and community services, etc.(Victoria State Government, 2016)

Actors

Fishermans Bend has hosted some large companies in its Employment Precinct (~230 hectares) for decades, such as Boeing, Siemens and Toyota. Other innovative companies are being attracted to the area (Victoria State Government, 2021c).

The University of Melbourne plans to move its Engineering and Design Schools there in 2023 building a new campus for large experimental research, hands-on learning, and industry colocation. RMIT has also shown interest in moving to Fishermans Bend and other universities are expected to settle there in the next few years.

By 2050, Fishermans Bend is expected to be home to approximately 80,000 residents and provide employment for up to 80,000 people, targeting 80% of transport movements to be made by public transport, walking or cycling (Victoria State Government, 2021b).

Innovation and collaboration

Currently, the levels of both innovation and collaboration in Fishermans Bend are low, due to the lack of universities, research centres, and innovative business beyond Boing, Siemens or Toyota.

However, this is expected to change with the arrivals of new business to the current Employment Precinct and the universities, some of which already have a relationship with some of the businesses set there. For example, RMIT has strong and strategic collaboration with Boeing, including undergraduate education, postgraduate research and collaborative research (RMIT, 2016).

4. Implications for policymakers related to the case studies

The cases presented in this report are very diverse, which proves that there is not a one-size-fits-all approach for the planning and implementation of geographies of innovation and that these are very context and opportunity dependent. However, there are a set of characteristics in each of the aspects that policymakers could consider if they are involved in the planning, design or implementation of these geographies.

Leadership and governance

The geographies presented are led by higher education institutions, by public companies or by a consortium of organizations. Even when this factor might determine the focus of the geography, there are a set of principles of strong leadership that can be applicable to all of them.

The development of these geographies needs a clear mission and vision, whether this is more knowledge, high-tech or employment oriented, and these statements need to be a strong base for the development of the strategies, the structures and the activities. This alignment is essential, but the long-term development of these geographies sometimes require a change to this approach and leaders must ensure a new alignment.

The new geographies in Australia are merging precincts with different characteristics and some of which already had their own leadership. In these cases, this double layer of governance might be also possible – it is still too early to say - although it will require greater coordination efforts and very good understanding of how to smoothly transition to the new situation.

Since the ultimate aim is to foster social and economic development through innovation, a civic leadership approach is needed to ensure that the ideas and relationships enable the leaders to change the lives of those who work and live in their geographies for the better. For this the organizations leading these geographies should be able to coordinate the different stakeholders, sometimes with strong partnerships and make sure their voices are heard. Often this happens with formal advisory boards that are made of representatives of the governments, organizations and communities.

Effective governance should also guide the structures and actions of the geography's leadership, ensuring the creation of value while providing a long-term sustainable financial planning with accountability and control systems. An ethical approach is also key to manage any potential land legacies and ground conditions and a sustainable one to drive the overall social, environmental and economic planning for the geography.

The leadership of these geographies described has different approaches in respect to programming a set of activities within the geography. Even when there are geographies that operate without an active entity in programming, the more active the role of the leadership in organising events, joint activities or networking opportunities, the higher the dynamism of the geography and the opportunities for innovation and collaboration.

Physical space

This report shows how it is possible to plan and implement geography from scratch or to plan it around existing infrastructures, whether these are industrial (e.g. Sodertalje), scientific or educational (e.g. MID). No matter what the starting point is, the aim of policymakers should be a vibrant mix of land uses and activities. This means, enough space should be guaranteed for innovative business, higher education and research centres that will likely be the anchor institutions. Apart from them, the conditions should be put in place for a large community of start-ups to emerge, and this is likely to include the presence of incubators, accelerators or co-working spaces. Then third places can be added: shops, restaurants, gyms and other amenities where people can meet outside work. The latest developments are also considering residential areas within the geographies, but making sure that there are affordable and diverse housing options close to jobs.

Buildings should be porous, including large windows and common areas, and integrate shared spaces for formal or informal interactions among the actors of geography, and even the internal or neighbouring communities. Geographies of innovation should plan for enough open spaces and green areas to increase the liveability of the place. Another of the critical elements of physical space is connectivity, so policymakers must consider the implementation of integrated transport networks, mostly made of public transport or bike lanes, that support economic growth. Geographies of innovation should be as much as possible walkable spaces that allow people to move around the geography comfortably and securely by foot.

In the development or renewal of these physical spaces, the current and advisable approach is more sustainable. A climate change resilient and resource efficient space that meets the needs of people living, working and visiting the geography. The combination of all the aspects above, results in a vibrant, attractive, liveable and high-quality urban environment that promotes social and economic growth while attracting further investment.

The districts in Australia have a larger extension than those in Sweden and this poses a question as to whether there should be the limitation of a geography in terms of size. Ideally, it is one in which everything is walking distance, but in a few years we will be able to see whether a strong network of public transport within the geography can compensate for the large size and the low walkability and still sufficiently connect the different actors.

Actors

The geographies of innovation described in this document host different combinations of actors within their boundaries, however all of them have or are planning a high density of organizations and talent. All cases described have higher education institutions and innovative business and most of them research centres, which are considered critical for these geographies. Therefore, the planning and designing of these geographies should always be considered as anchor institutions for these three types of actors, or at least the first two if higher education institutions are research intensive.

It is important to have a strategic plan around the organizations that are attracted, not only making sure they have an innovative profile and potential that can attract talent, but also that these organizations complement the current ones to increase the possibilities of collaboration. The presence of intermediaries, enablers or supporters of other organizations (e.g. incubators, accelerators, training providers, associations, etc.) will be critical for the performance of the geography.

Sometimes the offer is complemented with a technical or vocational education centre, which can be critical to develop the technicians that will work in the geography. Or even with a school, that can be very useful for the kids of the workers or residents. Third places are also important in these geographies, so policymakers should consider space for restaurants, shops, gyms and other amenities.

In the latest development and current planning, residents are also considered to be an important part of these innovation ecosystems who add to a vibrant mix of actors and whose participation is encouraged in the activities of the geography and increase the sense of community. Affordable and diverse residential areas are being promoted (e.g. Fishermans Bend and Monash NEIC). Generally, the higher the variety of actors, the higher the possibilities of synergies, cross-pollination and collaboration that is mutually beneficial.

Innovation and collaboration

The cases show how the aim is for most organizations in the geography to be innovative so they can contribute to the purpose of the geography, when this is not the case, there are always plans to change this (e.g. transform more industrial into more technologically advanced and knowledge-based geographies). Therefore, it is always beneficial when there are high level policies that facilitate the attraction of these types of organizations.

However, taking full advantage of its position would mean that these organizations increase their individual innovation even more by collaborating with other actors with complementary interest or resources. Higher education institutions and research centres are the best sources of innovation, whether this is because of the talent or research pipelines. Research will only transform into something that benefits the city if there are companies that transform that innovative research into tangible products or services, so policymakers need to consider that regulatory and soft policies in technology transfer are favourable enough for this to occur.

Likewise, the geography will only benefit from the talent developed by the university if these people can work in some of the companies of the area or are given favourable conditions to create their own company. Policies can also support companies that hire these graduates or the creation of new highly innovative companies that can be incubated, accelerated and finally established more permanently in the geography.

Governments across Europe support these geographies to become engines of sustainable economic and social development. The geographies are also excellent vehicles to implement Smart Specialisation Strategies building on local or regional strengths. However, the large number of specific policies and initiatives that should be in place to support every aspect of these geographies makes this a complex task. The Covid-19 pandemic is currently questioning the resilience of these geographies and the role that policymakers could have to better support them. It is still too early to confirm how geographies of innovation will look post-pandemic, but the quick and effective reactions of many of them to solve pressing societal problems in the last year has shown the benefits of organised fully-functioning place-based innovation ecosystems.

4.1.Main challenges to identify and define geographies of innovation

There are a wide range of challenges around the identification and definition of geographies of innovation, including:

Heterogeneous theory and practice

The literature that refers to geographies of innovation is not cohesive or consistent. It comes from different disciplines (e.g. urban studies, geography, policy, economics, development, engineering, real estate, innovation), so concepts, frameworks and theories are different and not always aligned.

In practice, this derives from using a large variety of names for specific geographies of innovation that are different in reality. This creates confusion and feeds into the development of a diverse and inaccurate literature.

Unclear boundaries of geographies of innovation

The limits of geographies of innovation are not always obvious, particularly in those geographies that have not been planned since the beginning or that are located within a city, tightly surrounded by other organizations or have another geography of innovation in close proximity.

The location of several of these geographies of innovation within a city or a region could result in the emergence of urban or regional innovation ecosystems. For example, Barcelona has an urban innovation ecosystem where two science parks, two technology parks and one innovation district coexist and increasingly interact.

Copenhagen is an exceptional example of this at a regional level. Ørestad Science City, Copenhagen Science City, Lyngby-Taarbaek City of Knowledge, and Frederiksberg Science City are recognised as individual geographies of innovation but they have developed a strong network, fostering innovative research with great business potential in areas as life sciences, green energy, quantum technology, IT and Big Data while increasing the impact of their activities.

The evolution of innovation geographies

The challenge of establishing the boundaries gets more complicated when considering that geographies of innovation are almost in permanent transformation. Sometimes this transformation is physical, usually by extending their physical area, but the organizations within a geography change as well as the sectors of specialization.

The consolidation of these geographies of innovation can take up to a decade and in this process, the changes are almost constant, which makes it difficult at times to track and evaluate their progress and success. A clear example of this evolution and changes is in the city of Melbourne. Almost a decade ago, some development of innovation environments started around the universities RMIT and University of Melbourne, both located in the central business district and close to each other. The success of their initiatives brought them together and Melbourne Connect laid the groundwork for the development of macro government policies that shaped the joint of nearby innovation geographies that are now known as Melbourne Innovation Districts.

Measurement geographies of innovation

The measurement of the operations and characteristics of geographies of innovation is difficult for several reasons. Geographies of innovation are not a standard territory for statistical purposes, so most data are not available in secondary sources. The primary data collection required can be expensive and time consuming, while sometimes, the limits of these geographies are not clearly defined and a lot of the activities within these geographies are intangible. Hence, recent research has proposed a generic and algorithmic methodology to identify areas with high concentration of innovation within cities and proposes a methodology to measure the success of such areas (Hegyi, Zhu and Janosov, 2021).

There are a wide range of stakeholders that perceive indirect or long-term benefit, while some organizations are only partly in a geography of innovation (e.g. an engineering faculty of a university, an R&D centre of a multinational company).

Longitudinal data for these geographies might be distorted, as the development of these geographies is often not linear. During the first few years, particularly if this is new land development/green field, data could be the result of a one-off transaction, decision or a particular policy of funding source. Therefore, the comparison of data over a long time might not be reliable or capture the real development of the geography.

Apart from the challenges around the measurement itself, the comparison of indicators among geographies of innovation in different regions or countries would not be fair as each geography is highly influenced by their specific location (their policies, their socio-economic situation, etc.). A fairer approximation would be to compare the indicators of a specific geography with the average of the city or region where it is located, to test whether these are significantly above the average.

4.2.Policy recommendations

The success of geographies of innovation has been varied and it is not always clear why some geographies of innovation do not reach their full potential, do it at a slower pace or fail to develop. Beyond the complexity of the management of these geographies, the existence and the types of policies as well as the policy approach applied in a specific territory can have a key influence on the emergence and development of geographies of innovation. Even when policymakers in each

European country and region will need to take different actions, this document reviews a set of key general recommendations applicable to all of them.

Particularly because one size does not fit all, the first recommendation is to design a set of evidence-based policies targeted to address the specific problems, needs and bottlenecks of the geographies of innovation in the area of implementation. These policies should also consider the strengths and weaknesses of the specific territory. However, a better information collection and flow is needed in order to design evidence-based policies.

If not previously available, the evidence required for these policies will need to be collected periodically and systematically through an adequate system that captures and integrates information on all the systemic elements.

Evidence is likely to show a large diversity of geographies of innovation, and when this is the case, policies should be designed as frameworks that allow bottom-up initiatives to occur, and consequently new players, value chains and industries can emerge. This is only possible when policies consider the entrepreneurial discovery process as a way to confirm innovation. The roadmap for the geography should allow its companies and institutions to find their strengths, their complementarities, their potential joint innovation opportunities. New policies should distance themselves from traditional industrial policies that often aimed to create or back winners (European Cluster Collaboration Platform, 2021).

This would allow geographies of innovation to behave like start-ups, including using lean testing, agile pivoting and taking to the market more successful products and services. With this base, they can work to align their investment agendas and design joint roadmaps that give them a competitive advantage and allow them to better contribute to key economic areas. The policy implementation should also be a continuous entrepreneurial discovery process of encouraging growth in related fields (DG Growth, 2016).

The policies to use geographies of innovation as smart innovation intermediaries within smart specialisations can be a very effective strategy. Specifically, geographies of innovation can support smart specialization strategies by acting as boundary openers between assets within the geographies and other geographies in the region, the regional environment and even internationally. This would allow them to link assets in the geographies with those outside, whether these are in the same region, country or internationally.

Due to the variety of geographies of innovation, policies could be designed using a stage-based approach adapted to their degree of development, as they will have different capabilities and needs. This is only possible if policymakers assign sufficient resources in a stable way in the long term to geographies of innovation, since they might take up to a decade to fully develop and many of them are in continuous evolution even after that. Policies should also vary depending on the nature of the geography of innovation. In geographies based on a public-private partnership, policymakers need to support the first stages to ensure the consolidation of the geography, but at the same time set the conditions needed for it to be financially self-sustaining in the long-term.

A series of particular policies are needed to support the geographies of innovation directly. However, new policies should distance themselves from traditional industrial policies and break the ´policy-silo pattern´ by tackling the entire system simultaneously, instead of specific components individually (European Cluster Collaboration Platform, 2021). This means, policymakers should support the management organization of these geographies to facilitate their coordination and networking efforts, including developing skills for geography managers. For example, policies should promote networking among the organizations within a geography, which is essential to create relationships in which explore collaboration opportunities and in the longer term undertake collaborative innovation.

In addition, each of the actors within the geography should be individually supported. Whether this is negotiating favourable sell or rent conditions for them to locate in the geography, or providing better conditions for their operations, whether this is by relieving organizations from national or regional income tax for an initial period of time and even grant them export and import duties exemptions. However, it is important to do this with organizations that are likely to add value to the geography, to collaborate with others, to attract other organizations and investments and to contribute to local and regional needs. The support of SMEs to grow is particularly important, whether this is directly or through the creation of a supporting ecosystem.

Due to the cross-sectoral nature of geographies of innovation, a better horizontal alignment between ministries of education, science, technology, innovation, industry, economy is required. Therefore, policymakers are recommended to share information and knowledge among them to avoid multiple agencies and information systems with overlapping mandates or gaps of unattended stakeholders. The policy mix for geographies of innovation could be considered as a new policy system itself that integrates in a coordinated way traditionally independent strategies, programmes and instruments.

Likewise, a better vertical alignment among local, regional and national policies and European initiatives is required. Through national policies policymakers will be able to achieve economies of scale, while local and regional policies would allow a government to address the specific problems of that territory. This alignment would highly increase the efficiency of public resources and the impact of current policies. While perfect horizontal or vertical alignments are not possible, more efforts should be dedicated to improving them, because both vertical and horizontal alignment is required for the application of an integrated policy strategy, which involves the matching of a wide range of coordinated policies goals and consistent policy means to a specific large-scale problem context.

The policies that contribute to the creation of a favourable business, higher education and science environment will be critical for the success of geographies, whether these are educational, scientific or industrial investment, infrastructure, strategies or programmes. While for universities this can be a stable base funding and incentives to keep their labs up to date or their curriculum aligned with the labour market needs, for businesses these policies can be related to tax benefits, a simple regulatory system or flexible funding mechanisms. For all stakeholders, good connectivity infrastructure is essential.

These policies can create strong organizations, but these should be complemented by policies that facilitate collaboration between the different stakeholders within a geography. These are related to knowledge and technology transfer and can be in the shape of programmes such as innovation vouchers for companies to use R&D support from universities, funding for joint R&D or joint venture creation that require the involvement of several organizations. Moreover, they can be tools such as innovation platforms, networking events or matchmaking tools (e.g. speed dating).

A wide range of social and macroeconomic policies also affect geographies of innovation to different extent and even when its modification will be unlikely, policymakers need to consider them to ensure a successful context for geographies of innovation. It is almost impossible to create a comprehensive list of factors that can affect geographies of innovation, but this document highlights some of the most important ones.

Most geographies do not have enough availability in the local labour market of the skills they are looking for, so migration policies will be something to consider. They start from a speedy and simple migration process, like the EU Blue Card implemented by 25 EU countries, or some national programmes (e.g. Danish Pay Limit Scheme in Denmark or Critical Skills Employment Permit in Ireland) and a soft landing process. When individuals are settled, retention is dependent on several factors, including future prospects, that can be shaped by policies that ensure access to citizenship, integration and political participation of migrants in the long-term.

However, there are other policies that contribute to talent feeling attracted to a specific location. The OECD Indicators of Talent Attractiveness (OECD, 2021) provides a signal of which aspects can be important to attract talent, whether these are university students, highly educated workers or entrepreneurs. These indicators include the quality of opportunities, which can be improved for example with efficient labour market policies or with education and science policies that help develop prestigious universities.

For individuals, earnings, cost of living and individual tax are also important factors that can be improved through policy. The family environment is also key for those who move with families, whether these are the immigration laws, labour market integration, childcare costs or family benefits. Inclusiveness, diversity, social attitudes towards immigration and gender equality are other aspects that can be critical for individuals to move and stay in a country and which policies can strengthen. At the end of the day, any of the factors included in the OECD Better Life Index is likely to affect geographies of innovation in a more direct or indirect way. It is important to ensure that the majority of the above mentioned policies are positive or at least not negatively influencing geographies of innovation.

Finally, the effects of the global pandemic of Covid-19 and the current global crisis make the push for efficient policies even more urgent and for geographies of innovation to be used as a critical tool to lead the recovery towards more green, sustainable and socially responsible cities. This crisis has helped policymakers to clearly see how geographies of innovation are more than attractive office buildings and labs, or real estate value. They can be well functioning ecosystems that can rapidly and efficiently transfer knowledge and technology and therefore a sensible investment for governments. There is a need to build back better, with bolder and systemic approaches and models and geographies of innovation have the potential to play an important transformative role in local, regional or even national economies.

5. Final remarks

For the last century, companies have clustered to achieve competitive advantage, and in the last four decades, these companies have also clustered with other organizations (e.g. universities, research centres, intermediaries) in order to collaborate. In practice, geographies of innovation have been emerging all around Europe in connection with policies to transition to high-tech industries, knowledge-based entrepreneurship, and science-based innovation. And beyond the organizational benefits, governments across Europe support these geographies to become engines of sustainable economic and social development. The geographies are also excellent vehicles to implement Smart Specialisation Strategies building on local or regional strengths. However, their performance and impact are difficult to measure.

The existing literature of these geographies is dispersed (urban studies, business management, sociology, public policy, etc.) and inconsistent. Even when there are a wide range of theories that can partly underpin these geographies (e.g. agglomeration theories, innovation theories, etc.), literature does not offer a completely established theory about their formation and development. In addition, the terms used for the different models of geographies are not commonly agreed upon nor their definitions. In order to better understand these geographies of innovation, a greater emphasis of complex system science and network theory could be made, always with a base in human capital theories.

Despite the significant advances, there are still many questions also unanswered in both theory and practice. The Covid-19 pandemic is currently questioning the resilience of these geographies. On the one hand, many geographies have been critical to support their cities and regions during the pandemic, by delivering solutions at a pace so rapid that only a well-functioning network of innovative organizations can deliver. On the other hand, the pandemic is putting a test to the extent to what effective remote working and online collaboration is possible and sustainable and thus placing a question mark on the need and advantages of colocation. It is already clear that this answer varies by sector and areas of knowledge, but it is still too early to say how geographies of innovation will look post-pandemic.

References

Ailstock, M. et al (2020) Innovation Zones: How the Federal Government can Create Thriving Place-Based Innovation Ecosystems. HR&A, The New Localism and Global Institute on Innovation Districts, United States. Available at: https://www.hraadvisors.com/innovation-zones/

Accenture (2020). Industrial clusters are critical to getting to net-zero. Here's why. Available at: https://www.accenture.com/us-en/blogs/accenture-utilities-blog/industrial-clusters-critical-getting-net-zero#:~:text=Industrial%20clusters%20are%20groups%20of,Suzhou%20Industrial%20Park%20(China).

Amoroso, S., A. Link and M. Wright (2019). Science and Technology Parks and Regional Economic Development: An International Perspective. Palgrave Macmillan. ISBN: 978-3-030-30963-3. DOI: 10.1007/978-3-030-30963-3.

Association of University Research Parks- AURP (2020). What is a research park? /Innovation District Available at: https://www.aurp.net/what-is-a-research-park+

ARUP (2018) UK Innovation Districts and Knowledge Quarters. Driving more productive growth. Available at: https://www.arup.com/perspectives/publications/research/section/innovation-districts-how-can-we-drive-growth-in-major-uk-cities

Atomico (2021) The State of European Tech 202. Available at: https://2020.stateofeuropeantech.com/chapter/state-european-tech-2020/

Bidwells Consulting (2020). What is a science park? Available at: https://www.bidwells.co.uk/insights-and-research/what-is-a-science-park/

Bloomberg Philanthropies and OECD (2021) City Innovation Website. Stockholm. Available at: https://cities-innovation-oecd.com/cities/stockholm-swe/

Buciuni G., y Pisano G., (2015). Can Marshall's Clusters Survive Globalization? .Working Paper 15-088. Harvard Business Review. Available at: https://www.hbs.edu/ris/Publication%20Files/15-088_cd4f1da8-4988-408b-b7eb-8c0e5798a398.pdf

Burke, J. and Grass Aloma, R. (2019) Atlas of Innovation Districts. Aretian and Opinno. Cambridge (MA) and Madrid

Burke, J. and Grass Aloma, R. (2020) El reto de las ciudades, los distritos de innovación y las cadenas de valor en la era de la economía global y la automatización. Panorama Social. Num 32, Second Semester 2020, pp. 33-48

Chaminade, C., P. Intarakumnerd and K. Sapprasert (2012) Measuring systemic problems in National Innovation Systems. Research Policy, 41 (8), 1476–1488.

City of Melbourne (2020) *Melbourne Innovation Districts City North Opportunities Plan 2020*. Available at https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.com-participate.files/2215/7404/5966/MID_CITY_NORTH_OPPORTUNITIES_PLAN.PDF

City of Melbourne (2021a) *Melbourne facts and figures.* Available at https://www.melbourne.vic.gov.au/about-melbourne/melbourne-profile/Pages/facts-about-melbourne.aspx.

City of Melbourne (2021b) *Melbourne Innovation Districts.* Available at https://www.melbourne.vic.gov.au/about-melbourne/melbourne-profile/smart-city/Pages/melbourne-innovation-districts.aspx

Coenen, L.; Morgan, K. (2020) Evolving geographies of innovation: existing paradigms, critiques and possible alternatives, Norsk Geografisk Tidsskrift - Norwegian Journal of Geography, 74:1, 13-24, DOI: 10.1080/00291951.2019.1692065

Crescenzi, R., Iammarino, S., Ioramashvili, C., Rodríguez-Pose, A. and Storper M. (2019) The geography of innovation: Local Hotspots and Global Innovation Networks. Economic Research Working Paper No. 57. World Intellectual Property Organization. Available at: https://www.wipo.int/publications/en/details.jsp?id=4471

Crupi, A., Del Sarto, N., Di Minin, A., Gregori, G.L., Lepore, D., Marinelli, L. and Spigarelli, F. (2020) The digital transformation of SMEs – a new knowledge broker called the digital innovation hub, Journal of Knowledge Management, Vol. 24 No. 6, pp. 1263-1288. Available at https://doi.org/10.1108/JKM-11-2019-0623

Dabinett, G. (2014). A new strategic approach to science cities. Oh. D-S., and Philips, F. (Eds)(2014) Technopolis. Best Practices and Technology Cities(pp.3-21). DOI 10.1007/978-1-4471-5508-9

Davey, T.; Plewa, C.; Galán-Muros, V. (2014) University-Business Cooperation outcomes and impacts – A European Perspective. In Kliewe, T. and Kesting, T. (Eds.) Modern concepts of Organisational Marketing. Ed. Springer Gabler, ISBN 978-94-91901-01-0

Delgado, M., Porter, M. & Stern, S. (2013). Defining Clusters of Related Industries, Working Paper 20375 of the National Bureau of Economic Research. Available at: www.nber.org/papers/w20375.

Digital Demo Stockholm (2021) About us and How we Work. Available at https://www.digitaldemostockholm.com/en/

European Cluster Collaboration Platform (2021) Cluster Policies. Definitions. Available at: https://clustercollaboration.eu/cluster-definitions

European Commission Directorate-General for Regional and Urban policy (DG REGIO) (2014) Setting up, Managing and Evaluating EU Science and Technology Parks. Luxemburg: Publication Office of the European Union. ISBN 978-92-79-37274-2.

European Commission Directorate General of Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) (2012) Industrial Cluster Policy. Available at: https://ec.europa.eu/growth/industry/policy/cluster_en.

European Commission, Directorate General of Internal Market, Industry, Entrepreneurship and SMEs, (DG GROW) (2016) Smart Guide to Cluster Policy. Luxemburg: Publication Office of the European Union. ISBN 978-92-79-52975-7

European Commission, Joint Research Centre (JCR) (2021) Smart Specialization Platform. Luxemburg: Publication Office of the European Union. Available at: https://s3platform.jrc.ec.europa.eu/what-is-smart-specialisation-

European Commission (2016). European Capital of Innovation 2016 – Amsterdam. Available at https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/prizes/icapital/icapital2016_en

European Commission (2021) European Innovation Ecosystems. Policy, Strategy and Work Programmes. Available at: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-innovation-ecosystems_en

European Commission (2021) European Digital Innovation Hubs in Digital Europe Programme. Draft working document. Available at: https://digital-strategy.ec.europa.eu/en/activities/edihs#:~:text=European%20Digital%20Innovation%20Hubs%20(EDIHs,challenges%20and%20become%20more%20competitive.

European Institute of Innovation and Technology (2020). EIT Innovation Hubs. Available at: https://eit.europa.eu/our-communities/eit-innovation-communities/innovation-hubs

European Union (2019) Regional Innovation Scorecard 2019. Luxemburg. ISBN 978-92-76-08723-6

Feldman M.P. (2016) Geography of Innovation. In: Augier M., Teece D. (eds) The Palgrave Encyclopedia of Strategic Management. Palgrave Macmillan, London. https://doi.org/10.1057/978-1-349-94848-2_537-1

Financial Times (2021). Amsterdam ousts London as Europe's top share trading hub. Available at https://www.ft.com/content/3dad4ef3-59e8-437e-8f63-f629a5b7d0aa

Flores M., Molina A. (2000) Virtual Industry Clusters: Foundation to Create Virtual Enterprises. In: Camarinha-Matos L.M., Afsarmanesh H., Erbe HH. (eds) Advances in Networked Enterprises. BASYS 2000. IFIP — The International Federation for Information Processing, vol 53. Springer, Boston, MA. Available at: https://doi.org/10.1007/978-0-387-35529-0_11

Fluor (2020). City of Amsterdam Project Zuidasdok. Available at https://www.fluor.com/projects/amsterdam-project-zuidasdok

Gras Aloma, R. and Burke, J. (2019) "Atlas of Innovation Districts," Harvard Innovation Lab. Aretian and Opinno. Available at: https://www.aretian.com/atlas-report?lang=es

Galán-Muros, V.; Davey, T. (2019) The UBC Ecosystem: Putting together a comprehensive framework for university-business cooperation. Journal of Technology Transfer, 44 (4), 1311-1346. doi: 10.1007/s10961-017-9562-3

Gebiedsontwikkeling (2012). Science Park Amsterdam. Available at https://www.gebiedsontwikkeling.nu/artikelen/science-park-amsterdam/

Hegyi, Fatime Barbara, Manran Zhu and Milan Janosov (2021), Measuring the Impact of Urban Innovation Districts, EUR 30825 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-41491-9, doi:10.2760/11053, JRC125559.

Hudson Institute of Medical Research (2021) *About us.* Available at: https://hudson.org.au/about/about-us/.

Iamsterdam (2019). Amsterdam gets a new innovation district. Available at https://www.iamsterdam.com/en/business/news-and-insights/news/2019/amsterdam-gets-a-new-innovation-district

Iamsterdam (2021a). Life sciences and health industry in Amsterdam. Available at https://www.iamsterdam.com/en/business/key-sectors/life-sciences-and-health

Iamsterdam (2021b). The Amsterdam Metropolitan Area. Available at https://www.iamsterdam.com/en/about-amsterdam/amsterdam-metropolitan-area

Iamsterdam (2021c). Zuidas. Available at https://www.iamsterdam.com/en/business/setting-up/business-locations/zuidas

ING (2019). The Cumulus Effect. Available at https://www.ing.com/Newsroom/News/The-Cumulus-effect.htm

Innovationsplatsen Karolinska (2021) *The innovation place*. Available at https://www.karolinska.se/innovationsplatsen.

Invest in Amsterdam (2020). Zuidas Kenniskwartier. Available at https://investinamsterdam.com/assets/zuidas-kenniskwartier__8f59f24539fc

Invest Victoria (2021) Monash National Employment and Innovation Cluster. Available at https://www.invest.vic.gov.au/opportunities/precincts/monash-national-employment-and-innovation-cluster

Issuu (2014). VU-VUmc Masterplan Campusontwikkeling 2014. Available at https://issuu.com/terralemon/docs/vu-vumc-masterplan-issuu2IADB (2011) Cluster Development Programs in Latin America and the Caribbean. Lessons from the Experience of the Inter-American Development Bank. Available at: https://publications.iadb.org/publications/english/document/Cluster-

Development-Programs-in-Latin-America-and-the-Caribbean-Lessons-from-the-Experience-of-the-Inter-American-Development-Bank.pdf

JLL (2019) Innovation Geographies. Available at: https://www.jll.com.au/en/trends-and-insights/research/innovation-geographies-2019

Kalpaka, A., Sörvik, J. and Tasigiorgou, A., Digital Innovation Hubs as policy instruments to boost digitalization of SMEs, Kalpaka, A., Rissola, G. (Eds.), EUR 30337 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-21405-2, doi:10.2760/085193, JRC121604.

Katz, B. and Wagner, J. (2014) "The Rise of Innovation Districts: A New Geography of Innovation in America," Brookings Institution, Washington D.C., Available at: https://www.brookings.edu/essay/rise-of-innovation-districts/

Karolinska Development (2021*) Who we are.* Available at *https://www.karolinskadevelopment.com/en/karolinska-investment.*

Karolinska Institute Science Park – KI Science Park (2021a). *About us.* Available at https://www.kisciencepark.se/om-oss/

Karolinska Institute Science Park – KI Science Park (2021b). Our campus areas. Available at: https://www.kisciencepark.se/motas-och-natverka/campusomraden/

Karolinska Institutet (2021a) *About Karolinska Institutet- a medical university.* Available at: https://ki.se/en/about#:~:text=Karolinska%20Institutet%20is%20one%20of,of%20medical%20courses%20and%20programmes.

Karolinska Institutet (2021b) Unit for Bioentrepreneurship. Available at: https://ki.se/en/lime/unit-for-bioentrepreneurship

Karolinska Trial Alliance – KTA (2021) About us. Available at: https://karolinskatrialalliance.se/om-oss/.

Karres en Brands (2021). Cumulus Park. Available at https://www.karresenbrands.com/project/cumulus-park

KTH (2021a). About KTH. KTH Solna. Available at: https://www.kth.se/om/kontakt/campus/kth-solna-1.790470

KTH (2021b) About KTH. KTH Södertälje. Available at: https://www.kth.se/en/om/kontakt/campus/kth-sodertalje-1.640336

Kista Business Network (2021) About the Network. Available at: https://kistabusinessnetwork.se/om-natverket/

Kista Science City (2021a) Kista Science City. Available at: https://kista.com/english/.

Kista Science City (2021b) For companies. Available at: https://kista.com/for-foretag/.

Kista Science City (2021c) Education and research. Available at: https://kista.com/utbildning-forskning/

Kista Science City (2021d) *Our business. Kista Science*. Available at: https://kista.com/var-verksamhet/. Lund, E., Addarii, F., Schmitz, H., Kokorotsikos, P. and Bush, R., Public-Private Partnerships for Science and Technology Parks. Utilising PPPs and related models for the development and operation of STPs and Innovation Districts, Kaymaktchiyski, S., Fazio, A. and Shamuilia, S. ed., EUR 30439 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25169-9, doi:10.2760/3057, JRC122409.

Kuzior, A and Kuzior, P. (2020) The Quadruple Helix Model as a Smart City Design Principle. Virtual Economics, Vol 1, Issue 3, pp. 39-57

Matrix Innovation Centre (2021). Home. Available at https://www.matrixic.nl/

Mazzucato, M. (2013) The entrepreneurial State: Debunking Public vs. Private Sector Myths. Anthem Press. London, England.

Melbourne Connect (2021) *Vision.* Available at https://melbconnect.com.au/purpose/vision/.

Melbourne Innovation Districts – MID (2021a) *What is MID?* Available at https://mid.org.au/what-is-mid/

Melbourne Innovation Districts – MID (2021b) *Social Innovation* Available at https://mid.org.au/program-of-work/social-innovation/

Morrison, A. (2014) Innovation Districts; An Investigation of the Replication of the 22@'s Barcelona Model in Boston, PhD Thesis, Utrech University.

Mulas, Victor; Nedayvoda, Anastasia; Zaatari, Ghia. (2017) Creative Community Spaces : Spaces That Are Transforming Cities into Innovation Hubs. World Bank, Washington, DC. World Bank. Available at: https://openknowledge.worldbank.org/handle/10986/28329

Nauwelaers, C., Kleibrink, A. and Stancova, K. (2014). The Role of Science Parks in Smart Specialisation Strategies. S3 Policy Brief Series, No. 08/2013. European Commission, Joint Research Centre, Institute for prospective Technological Studies, Spain. Available at: https://publications.jrc.ec.europa.eu/repository/handle/JRC90719

OECD (2000) Workshop 2: Local partnership, clusters and SME globalization. Conference for Ministers responsible for SME and Industry Ministers. Available at: http://www.oecd.org/cfe/smes/2010888.pdf

OECD (2013), *Green Growth in Stockholm, Sweden*, OECD Green Growth Studies, OECD Publishing, Paris, https://doi.org/10.1787/9789264195158-en.

OECD (2021) OECD Indicators of Talent Attractiveness. Available at https://www.oecd.org/migration/talent-attractiveness/

OpenLab (2021) About us. Available at https://openlabsthlm.se/about

Porter, M. (1998). Clusters and the New Economics of Competition. Harvard Business Review. Available at: https://hbr.org/1998/11/clusters-and-the-new-economics-of-competition

Padilla-Pérez, R. ed. (2013), Sistemas de innovación en Centroamérica. Fortalecimiento a través de la integración regional, Libro de la CEPAL, no. 118, Santiago de Chile: CEPAL, United Nations.

Padilla-Pérez, R. and Y. Gaudin (2014), "Science, technology and innovation policies in small and developing economies: the case of Central America", Research Policy, 43, 749-759.

PCB (2008) S'inaugura la Bioincubadora PCB-Santander. Available at: https://www.pcb.ub.edu/sinaugura-la-bioincubadora-pcb-santander/

Plewa, C.; Galán-Muros, V.; Davey, T. (2015) Engaging Business in Curriculum Design and Delivery - A Higher Education Institution perspective. Journal of Higher Education, vol. 70 (1), 35 -53

QS Top Universities (2021). Vrije Universiteit Amsterdam. Available at https://www.topuniversities.com/universities/vrije-universiteit-amsterdam

Queen Victoria Market (2021). *About.* Available at https://qvm.com.au/about/

Rissola G. (editor), Bevilacqua C., Monardo B. and Trillo C., (2019) Place-Based Innovation Ecosystems: Boston-Cambridge Innovation Districts (USA), EUR 29720 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-01950-3, doi:10.2760/183238, JRC116173.

Rissola, G. and Haberleithner, J., (2020) Place-Based Innovation Ecosystems. A case-study comparative analysis, EUR 30231 EN, Publications Office of the European Union, Luxembourg, , ISBN 978-92-76-19006-6, doi:10.2760/492676, JRC120695.

Ribeiro, J., Higuchi, A., Bronzo, M., Veiga, R., and De Faria, A. (2016). A Framework for the Strategic Management of Science & Technology Parks. Journal of Technology Management & Innovation [online]. 2016, vol.11, n.4, pp.80-90. http://dx.doi.org/10.4067/S0718-27242016000400011.

RMIT (2016) Boeing and RMIT fly higher with new strategic agreement. Available at https://www.rmit.edu.au/news/all-news/2016/april/boeing-and-rmit-fly-higher-new-strategic-agreement

RMIT University (2021) *RMIT Australia.* Available at https://www.rmit.edu.au/.

Runiewicz-Wardyn, M. (2009), *Innovation Systems Learning Process in the EU and US Regions*, Kozminsky University, Warsaw. Available at: https://iurd.berkeley.edu/wp/2009-06.pdf

Ruta N (2021). Medellin: De polo industrial a hub mundial de innovación. Available at: https://www.rutanmedellin.org/es/nosotros/ruta-n/medell%C3%ADn-hub-mundial-de-innovaci%C3%B3n

SciLifeLab (2021) About us. Available at: https://www.scilifelab.se/about-us

SLL Innovation (2021*) Stockholm Innovation Region*. Available at: https://www.sll.se/innovation.

Södertälje Science Park - SSCP (2021a). The inauguration of Södertälje Science Park. Available at: https://sscp.se/sodertalje-science-park/invigningen-av-sodertalje-science-park/

Södertälje Science Park - SSCP (2021b) Our profile area. Available at: https://sscp.se/sodertalje-science-park/vart-profilomrade/

Södertälje Science Park – SSCP (2021c). About Us. Available at: https://sscp.se/sodertalje-science-park/

Södertälje Science Park – SSCP (2021d). *Our main partners*. Available at: https://sscp.se/sodertalje-science-park/vara-huvudpartners/

Södertälje Science Park – SSCP (2021e). Strategic partners. Available at: https://sscp.se/sodertalje-science-park/strategiska-partners/

Södertälje Science Park - SSCP (2021f). Ongoing Project*.* Available at: https://sscp.se/sodertalje-science-park/pagaende-projekt/.

STEM Foundation (October 12th 2015). Innovation Hubs-a structured platform for sustainable growth. Available at: https://stemfoundation.org.uk/blog/2015/innovation_hubs_-_a_structured_platform_for_sustainable_growth

Stockholm Discovery (2021). Kista Science City. Available at: https://www.stockholmdiscovery.se/business-visits-lectures/2019/3/1/kista-science-city

Stockholms Stad (2021) Hagastaden. Available at: https://vaxer.stockholm/omraden/norrmalm-hagastaden/

Swedish Incubators and Science Parks - SICP (2018). Södertälje Science Park opened up for business today. Available at: https://www.sisp.se/start/s%C3%B6dert%C3%A4lje-science-park

Swedish Testbeds (2021). Stiftelsen Electrum. Available at: https://swedishtestbeds.com/profil/stiftelsen-electrum

Taivonen, T.; Friederici, N. (2015) Time to Define What a “Hub” Really Is. Stanford Social Innovation Review. https://ssir.org/articles/entry/time_to_define_what_a_hub_really_is#

The Economist Intelligence Unit (2021) The Global Liveability Index 2021. Available at: https://www.eiu.com/n/campaigns/global-liveability-index-2021/

The Global Institute on Innovation Districts (2019). The Evolution of Innovation Districts: The New Geography of Global Innovation. Available at https://www.giid.org/the-evolution-of-innovation-districts/#subscribe-for-download-file

The Office Operators (2021). Office Space Amsterdam South Axis NoMA House. Available at https://www.theofficeoperators.com/office-space/amsterdam/south-axis-noma-house/

The Royal Women's Hospital (2021) Our history. Available at: https://www.thewomens.org.au/about/our-history

Times Higher Education (2018). Amsterdam University of Applied Sciences. Available at https://www.timeshighereducation.com/world-university-rankings/amsterdam-university-applied-sciences

Toivonen and Friderici (2015) Time to Define what a ´hub´ really is. Innovation Review. Available at: https://ssir.org/articles/entry/time_to_define_what_a_hub_really_is#

UAB Universitat Autònoma de Barcelona (2021a). Home. Available at https://www.uab.cat/en/

UAB Universitat Autònoma de Barcelona (2021b). Research. Available at https://www.uab.cat/web/research-1345666325304.html

UK Petroleum Industry Association (2020) Industrial Clusters. Available at: https://www.ukpia.com/future-vision/future-vision-hub/industrial-clusters/

UK Science Park Association (2019). The United Kingdom Science Park Association. Connecting Innovation Places. https://issuu.com/ukspa1/docs/membership_brochure_final_28aug19_compressed1

UNIDO (1997) Guidelines for the Establishment of Industrial Estates in Developing Countries in International Guidelines for Industrial Parks. Available at: https://www.unido.org/sites/default/files/files/2020-05/International_Guidelines_for_Industrial_Parks_EN.pdf

United Nations, UNCTAD (2015) Policies to promote collaboration in science, technology and innovation for development: the role of science, technology and innovation parks. Available at: https://unctad.org/system/files/official-document/ciid30_en.pdf

University of Amsterdam (2020a). Physics2market grant for pilot Open Kitchen Labs. Available at https://hims.uva.nl/content/news/2020/12/physics2market-grant-for-pilot-open-kitchen-labs.html?cb

University of Amsterdam (2020b). Rankings. Available at https://www.uva.nl/en/about-the-uva/about-the-university/rankings/rankings.html#US-News-Best-Global-Universities

University of Melbourne (2021) *Welcome to the University of Melbourne.* Available at https://www.unimelb.edu.au/.

UPC (2021a). Campuses and broader presence. Available at https://www.upc.edu/en/the-upc/campuses-and-broader-presence#

UPC (2021b) Companies. Available at https://www.upc.edu/en/companies/companies

UPC (2021c). Entitats. Available at https://www.upc.edu/parcupc/ca/entitats

UPC (2021d). Presentació. Available at https://www.upc.edu/parcupc/ca/presentacio

UPC (2021e). QS World University Rankings By Subject Edition Of 2021. Available at https://www.upc.edu/ranquings/en/upc-at-international-rankings/rankings/qs-world-university-rankings-by-subject#:~:text=QS%20World%20University%20Rankings%20by%20Subject%20Edition%20of%202021&text=The%20world%27s%20leading%20universities%20are,46th%20in%20Electrical%20%26%20Electronic%20Engineering

UPC (2021f). UPC Group. Available at https://www.upc.edu/en/the-upc/structure-and-organization/upc-group

UPF (2021a). UPF in rankings. Available at https://www.upf.edu/en/web/universitat/la-upf-en-els-ranquings

UPF (2021b). Welcome to UPF Barcelona School of Management. Available at https://www.bsm.upf.edu/en/about-us

Victoria Planning Authority (2016) *Monash NEIC. Future Planning Ideas.* Available at~~:~~ https://vpa-web.s3.amazonaws.com/wp-content/uploads/2016/08/Future_Planning_Ideas_Map_WEB.pdf

Victorian Planning Authority (2017) *Monash National Employment and Innovation Cluster.* Available at https://vpa-web.s3.amazonaws.com/wp-content/uploads/2017/03/Monash-NEIC-framework-plan_March2017_WEB.pdf

Victoria Planning Authority (2021) Monash NEIC. Available at:~~-~~https://vpa.vic.gov.au/project/monash-employment-cluster/#supporting-documentation

Victoria State Government (2016) Fishermans Bend Framework. Available at https://www.fishermansbend.vic.gov.au/__data/assets/pdf_file/0020/35093/Fishermans-Bend-Framework.pdf

Victoria State Government/Jobs, Precincts and Regions (2021a) *Parkville.* Available at *https://djpr.vic.gov.au/significant-projects/business-precincts/parkville*

Victoria State Government/Jobs, Precincts and Regions (2021b) ~~Fishermans Bend.~~ ~~About US.~~ Available at https://www.fishermansbend.vic.gov.au/about-us

Victoria State Government/Jobs, Precincts and Regions (2021c) Precincts.~~—~~Fishermans Bend Innovation Precinct and the future of advanced manufacturing, engineering and design~~.~~ Available at https://www.fishermansbend.vic.gov.au/precincts/innovation-precinct

VU – Vrije Universiteit Amsterdam (2014). Campus in ontwikkeling. Available at https://www.vu.nl/nl/over-de-vu/campus/ontwikkeling/index.aspx

VU – Vrije Universiteit Amsterdam (2021a). Campus van de toekomst. Available at https://www.vu.nl/nl/over-de-vu/campus/toekomst/index.aspx

VU – Vrije Universiteit Amsterdam (2021b). Innovation And Enterprise On The Vu Campus. Available at https://www.vu.nl/en/about-vu-amsterdam/campus/starting-a-company/index.aspx

Walcott, S.M. (2020) Entry “industrial park” in the International Encyclopaedia of Human Geography (Second Edition) Available at: https://www.elsevier.com/books/international-encyclopedia-of-human-geography/kobayashi/978-0-08-102295-5

Wagner, J., Katz, B., and Osha, T. (2019) The evolution of innovation districts. The new geography of global innovation. Available at: https://www.giid.org/wp-content/uploads/2019/05/the-evolution-of-innovation-districts.pdf

Welcome to Barcelona (2021). What is Barcelona’s 22@ District?. Available at https://www.shbarcelona.com/blog/en/barcelona-22/

West L. (1998) The Development of Science and Technology Parks and Innovation Centres. In: Corsi C., Kudrya S.V. (eds) Globalization of Science and Technology: A Way for C.I.S. Countries to New Markets. NATO ASI Series (Series 4: Science and Technology Policy), vol 18. Springer, Dordrecht. Available at: https://doi.org/10.1007/978-94-011-5074-3_5

World Bank (2013) Clusters of Competitiveness. Available at: http://documents1.worldbank.org/curated/en/152521468158381169/pdf/Clusters-of-competitiveness.pdf

World Bank and IFC (2008) International Good Practice for establishment of Sustainable IT Parks. Washington, D.C. Available at: http://documents1.worldbank.org/curated/en/285041468273280230/pdf/474860WP0REPLA10Box334138B01PUBLIC1.pdf

Xpcat (2021). Parc Científic de Barcelona. Available at http://www.xpcat.net/parcs.php?idm=3&pagina=2&subpagina=1&parc=1&a=&m=

Yun, JHJ, Liu, Z. (2019) Micro- and Macro-Dynamics of Open Innovation with a Quadruple-Helix Model. Sustainability, vol 11, Issue 11. doi:10.3390/su11123301

List of figures

List of tables

Annexes

Annex 1: Definitions

Geography of Innovation

“The geography of innovation refers to the spatial clustering of innovative activity and the advantages conferred by co-location” (Feldman, 2016).

Industrial Park

“A special area on the edge of a town where there are a lot of factories and businesses (Cambridge Dictionary).

“An area especially for factories, on the edge of a town (Oxford Dictionary).

“a tract of land developed and sub-divided into plots according to a comprehensive plan with the provision of roads, transportation and public utilities, sometimes also with common facilities, for use by a group of manufacturers” (UNIDO, 1997).

“An industrial park consists of a piece of land designed specifically to promote industrial activities through integration with transportation facilities and other supportive infrastructure” (Walcott, 2020).

Industry Cluster

“District type that grows around dominant corporations. It is characterized by strong specialization and concentration of related industries in close proximity to strategic suppliers” (Burke and Grass, 2019).

“Industrial clusters are groups of industries, such as cement, steel and chemicals, physically in the same location. Europe is home to 3,000 such industrial clusters, representing 54 million jobs. Notable global examples include Humber (UK), Nagoya (Japan) and Suzhou Industrial Park (China)” (Accenture, 2020).

Cluster

“A cluster is a system of interconnection between private and public sector entities. It usually comprises a group of companies, suppliers, service providers, and associated institutions in a particular field, linked by externalities and complementarities” (World Bank, 2013).

“Clusters are geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition” (Porter,1998).

“Clusters should be considered as regional ecosystems of related industries and competences featuring a broad array of inter-industry interdependencies. They are defined as groups of firms, related economic actors, and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise, services, resources, suppliers and skills. Clusters are referred to both as a concept and a real economic phenomenon, such as the Silicon Valley, the effects of which, such as employment concentration, can be measured” (Delgado, Porter & Stern, 2013).

“Clusters are productive agglomerations aiming at exploiting local linkages to generate and strengthen competitive advantages” (IADB, 2011).

“A cluster is an agglomeration of firms in a related line of business. A cluster can contain a small or large number of enterprises, as well as small and large firms in different proportions. Some clusters, such as many of Italy’s industrial districts, are comprised principally of SMEs” (OECD, 2020).

“The 'cluster concept' seeks opportunities between adjacent industries for integrated processes, operations and business models”. (UK Petroleum Industry Association, 2020).

Business Park

“An area that is specially designed to have business offices, small factories, etc. (Cambridge Dictionary).

“An area of land that is specially designed for offices and small factories (Oxford Dictionary).

Research Parks

“Research parks focus largely on research or research and development, with no production in the park. The presence of public research organizations in the park, including research institutions and universities, is critical” (United Nations, UNCTAD).

“Research parks are usually located close to one or more universities or similar academic and research institutions. Its emphasis is on research rather than development and the key is academic/research liaison at the leading edge of science and technology. Normally, production plants are precluded (Dabinett, 2014).

"Physical environments that can generate, attract and retain science and technology companies and talent in alignment with sponsoring research institutions that include universities, as well as public, private and federal research laboratories. Research parks enable the flow of ideas between innovation generators such as universities, federal labs, and non-profit R&D institutions and companies located in both the research park and the surrounding region” (Association of University Research Parks, AURP).

Science Parks

“An area, often started or supported by a college or university, where companies involved in scientific work and new technology are based” (Cambridge Dictionary).

“An area where there are a lot of companies or organizations involved in scientific research and development (Oxford Dictionary).

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

“A property-based initiative which has formal and operational links with a university or other higher education institute, or other major Centre of research is designed to encourage the formation and growth of knowledge based businesses and other organizations normally resident on site has a management function which is actively engaged in the transfer of technology and business skills to the organizations on site” (UK Science Park Association).

“Science parks focus on research, development and design, which includes research and new product and process development and design, while actual production generally takes place elsewhere. The presence of public research organizations in the park, including research institutions and universities, is critical” (United Nations, UNCTAD).

“Is a purpose-built cluster of office spaces, labs, workrooms and meeting areas designed to support research and development in science and tech” (Bidwells Consulting).

“These are probably the simplest way to plan and develop new technology districts and industrial spaces. Local authorities, development agencies, European state governments and the European

Commission have supported them, with the aim of creating environments favourable to technology transfer and technological development. The main focus of science parks is to boost the creation of technology-based firms" (Dabinett, 2014).

Science and Technology Parks

"Science and Technology Parks have typically evolved around tertiary educational institutions or other research organizations. The role of science and technology parks has been to: recruit and co-locate new and established knowledge-based companies; promote innovation based on "smart" technologies; provide an interface or shared research environment for research organizations and private industry; and leverage local knowledge resources to enhance a region's economic base" (World Bank and IFC, 2008)

"Science and Technology Park designate a type of specialized cluster aimed at stimulating collaboration between the research system and firms in order to stimulate innovation based on research and development" (United Nations, UNCTAD, n.d.).

"Science and technology parks (STPs) are very common instruments used by regional and national authorities for regional development. Their main objective is to foster science-based growth poles to stimulate economic diversification away from declining industries" (European Commission, Joint Research Centre, n.d.)..

Technology Parks

An area where companies involved in new technology are based (Cambridge Dictionary).

Technology parks focus on production as well as research, development and design and host high-technology firms and may or may not include public research organizations (United Nations, UNCTAD).

"A development to accommodate companies engaged in the commercial application of high technology, with activities including R&D, production, sales and servicing. It is distinguished from science and research parks because of a greater emphasis on production. Academic involvement is also essential" (Dabinett, 2014).

Innovation Districts

"Innovation districts are geographic areas where leading-edge anchor institutions and companies cluster and connect with startups, business incubators, and accelerators. They are also physically compact, transit-accessible, and technically wired and offer mixed-use housing, office, and retail" (Katz and Wagner, 2014)

"An innovation district is a specific geographic location, generally within a city, where high concentrations of people work in knowledge-intensive industries in conjunction with other related companies and institutions. Innovation Districts also provide a mix of attractive amenities, housing options, and public spaces to enhance the desirability of the community" (Gras and Burke, 2019).

"Innovation Hubs constitute the backbone of an Innovation Community and should have a strong management, enabling collaboration within the Hub itself and with partners from other Hubs. There should be an inbuilt simplification agenda to keep overheads and management costs low" (European Institute of Innovation and Technology).

"An Innovation Hub presents a compelling platform for harnessing capability, focusing investment and stimulating enterprise. The key to successful innovation hub development is to cluster the organization's capability around new and emerging economic areas of growth" (STEM Foundation).

"A space that has community managers that integrate many of the other functions of creative community spaces. Innovation hubs' main function is to coordinate all actors of the ecosystem and help manage the community of tech-innovators and entrepreneurs to grow sustainably. Many of these innovation hubs enjoy the participation of the most relevant actors of the technology innovation ecosystem, including entrepreneurs, universities, private sector, creative community spaces, and government — particularly city government" (Mulas, Nedayvoda, & Zaatari, 2017).

Annex 2: Characteristics of universities' publications

		Publications % top 10	National Position	% Collaborative Publications	National Position	% Collaborative Pub. with industry	National Position	% Collab. Pub with partner < 100km	National Position	% Pub.in Open Access	National Position
Stockholm	Royal Institute of Technology (KTH)	10.60%	8 of 12	85.3%	4 of 12	13.2%	2 of 12	9.3%	4 of 12	52.9%	11 of 12
	Stockholm University	12.40%	2 of 12	87.3%	2 of 12	4.6%	12 of 12	8.2%	7 of 12	67.6%	1 of 12
	Karolinska Institutet	12.90%	1 of 12	90.0%	1 of 12	8.4%	5 of 12	12.9%	1 of 12	67.3%	2 of 12
Barcelona	Universidad de Barcelona	11.00%	5 of 41	89,7%	2 of 41	5.3%	8 of 41	14.6%	12 of 41	60.5%	9 of 41
	Universidad Politécnica de Barcelona	8.5%	17 of 41	78,6%	28 of 41	6.0%	6 of 41	17.3%	4 of 41	80.7%	1 of 41
	Universidad Autónoma de Barcelona	9,60%	9 of 41	88,1%	5 of 41	5.4%	7 of 41	16.7%	6 of 41	57.0%	10 of 41
	Universidad Pompeu Fabra	12,90%	1 of 41	93,0%	1 of 41	5.3%	9 of 41	15.5%	9 of 41	71.8%	3 of 41
Amsterdam	University of Amsterdam	15.30%	2 of 13	87.7%	3 of 13	6.4%	11 of 13	18.7%	5 of 13	63.8%	5 of 13
	Vrije Universiteit Amsterdam	14.10%	5 of 13	90.0%	1 of 13	6.6%	10 of 13	21.6%	2 of 13	63.5%	6 of 13
Melbourne	RMIT	11.60%	16 of 31	82.7%	28 of 31	4.0%	12 of 31	13.8%	14 of 31	30.0%	31 of 31
	University of Melbourne	12.90%	4 of 31	85.3%	13 of 31	5.5%	1 of 31	17.5%	2 of 31	55.3%	5 of 31
	Monash University	13.00%	1 of 31	87.1%	6 of 31	4.5%	5 of 31	17.0%	3 of 31	46.6%	19 of 31

Source: Own elaboration with data from Leiden Ranking CWTS, 2015 – 2018

KJ-NA-30871-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/268816

ISBN 978-92-76-42639-4