Areas of Innovation

Jacques van Dinteren
Paul Jansen

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Innovation Area Development Partnership

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Cover design and styling: Jacques van Dinteren

Photos: Jacques van Dinteren, Paul Jansen, William Jezequiel

This book can be ordered by sending an e-mail to zjak.consult@gmail.com

Contact IADP: pj.caudata@gmail.com

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Five years IADP

In 2016 we established the Innovation Area Development Partnership (IADP). Before, the two of us had been working on knowledge-intensive area developments globally and developed a preference for interdisciplinary teams. We strongly believe that such a working method leads to a better process and, in the end, higher-quality output. We thought it would be a good idea to apply this experience specifically to innovation areas; campuses, industrial co-innovation parks, science parks and innovation districts. Today these areas of innovation are driving forces in economic development. It is a complex challenge to create and manage these buildings, locations and districts.

Our initiative was greeted with great enthusiasm, and soon we had formed a team of international design, consultancy, finance and engineering firms who assist initiators, owners, investors, developers and managers of innovation areas all over the world. After establishing the organisation and sought publicity, we were surprised to find many questions from managers of innovation areas to join us as well. At first, we didn't count on this (semi)public sector response, but this interest was more than welcome.

Today the IADP is a well-known Dutch-based partnership that connects a network of like-minded professionals and shares insights on these knowledge-intensive work environments. The emphasis lies on interdisciplinary projects, research, knowledge development, and, above all, knowledge sharing. Moreover, the IADP offers the combined expertise to support developers, investors, companies, knowledge institutes and governments working on the (re)development and management of different types of innovation areas.

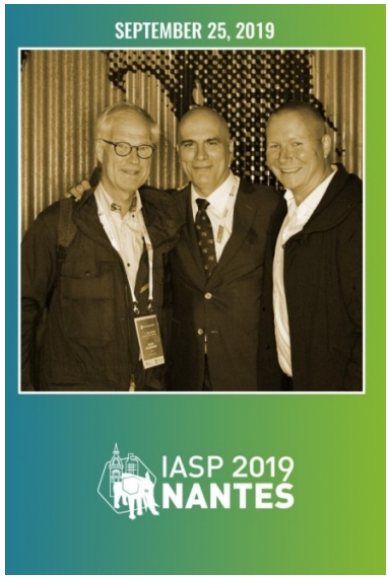
We also share our knowledge with a larger audience by engaging them in all kind of activities, giving lectures, and writing articles. We see this jubilee book as an excellent opportunity to present some of our ideas and views. We believe that this book provides all kind of ideas and insights that will contribute to better and stronger innovation areas. In the meantime, we will continue our activities, work together and look forward to the following five years of IADP.

The founding partners,
Em. prof. dr. Jacques van Dinteren
Paul Jansen MSc

IADP in the picture

IADP Winter Seminar, 2018

Project meeting, 2016



IASP World Conference, 2019

1. Facilitating knowledge development; from science park to innovation district

Modern economies see many innovative companies and institutions that are involved in data, knowledge and information, and in acquiring, researching and passing these on. For the majority of these organisations, an office building is sufficient. However, when it comes to fundamental research, particularly in the field of science and technology, stricter requirements are imposed.

Some of the innovative companies need specific work location concepts that respond to this. In general, we distinguish three types of innovation areas:

- The science park[1] that creates a business environment for innovation-oriented companies, knowledge institutions and support services. Many science parks have been formed around a university or another knowledge institution (sometimes located at a greater distance).
- The industrial co-innovation park that is comparable to a science park, but where the companies and institutions do not have a knowledge institution or university as a pivot, but a leading innovative company (think, for example, of the DSM campuses in The Netherlands).
- The innovation district that has a strong mix of functions (knowledge institutions, innovative companies, housing and facilities) and that can usually be found in or around city centres. In many cases, the realisation of such a district coincides with a restructuring of the urban environment. The concept is emerging in Europe (already more established in the United States) and currently has 22@barcelona and Knowledge Quarter in London as examples.

This chapter discusses those specific concepts and how they have evolved from a real estate concept to a more economic, network and community concept. Moreover, new ideas have emerged over the past two decades, which we will discuss here.

Characteristics of science parks

Knowledge development and innovation are essential elements in the economies of most countries. Successful innovation policies cannot ignore the physical environment that companies - large and small - need to successfully work on ideas, knowledge generation and knowledge exchange, aimed at innovative products and services. Usually, these are unique buildings and involve large investments in offices as well as laboratories, clean rooms, small-scale (pilot) production units, and so on. These can thrive in many places, but economic researchers assume that a concentration of such buildings - and, in fact, of

[1] In this book we classify technology parks among science parks.

innovative companies - leads to added value for the companies located there. Although research into these effects shows somewhat mixed results, the assumed added value of clustering has resulted in the establishment of numerous science parks. Numbers are difficult to give, in the absence of a clear definition. An indication is the number of members of the International Association of Science Parks and Areas of Innovation (IASP; see www.iasp.ws): currently around four hundred.

When it comes to clustering innovative companies, the science park is relatively the oldest concept. Since the creation of science parks in the early 1950s, quite a few different definitions have been given. For example, the IASP places a strong emphasis in the science park as an organisation of professionals who are committed to the exchange of information flows between companies and knowledge institutions, who promote innovation in companies and who help start-ups and spin-offs.

Hansson (2004), on the other hand, takes a closer look at its appearance and establishes, based on various definitions, that it almost always involves the physical proximity of a university, a focus on knowledge and high-tech companies and that there is an organisation in place that helps start-ups.

We are in favour of the definition of the IASP. In our opinion, it is primarily about stimulating innovation through well-functioning networks. Real estate and area development cannot be left out, but are of secondary importance here.

The development of science parks is a relatively recent phenomenon: only 4% of European science parks were established before 1980; 27% were established in the 1980s and the rest after (European Commission, 2014). Science parks are mainly an urban and even more so a metropolitan phenomenon. A random sample shows that only 6% of the parks are located outside a city, and 40% can be found in a city with more than a million inhabitants (see www.iasp.ws/statistics).

In Europe, two-thirds of science parks are located on university grounds, and 17% of the parks are no more than 5 km away from a university (European Commission, 2014). Earlier research by the IASP showed that worldwide, in about 40% of cases, the university is located in or near the science park. The lack of a clear link with a university can lead to malfunctioning (Ratinho et al., 2007). Incidentally, malfunctioning can also be the case if the concept is not taken seriously and companies establish themselves there mainly because of its image (see chapter 3).

Incidentally, this relationship with the university is not necessarily based on an intense exchange of knowledge between the knowledge institution and the companies based in the park. The availability of all kinds of facilities and a pool of students (work placements) and graduates play an important role and sometimes

seem more important than knowledge exchange (European Commission, 2014; see chapter 3). In itself, it should not be so strange that a company for the exchange of knowledge and co-innovation is not focused on the adjacent university. When it comes to crucial knowledge or information, this transcends the region in which the company is located (Weterings & Ponds, 2007). Yet it is the mutual relationships between companies and knowledge institutions that distinguish a science park from a regular business park or office park. The management of a science park (that there is management, is also a distinguishing feature) usually puts a lot of effort into these relationships and tries to promote contacts between companies, and between companies and knowledge institutions. This creates an informal circuit ('local buzz') that leads to substantial positive effects in the creation of innovation networks between local actors (Capello & Morrison, 2005), although a book can also be written about the differences of opinion on this point.

Although stimulating networking, cooperation, and the exchange of knowledge are essential for well-functioning area management, attention is equally focused on creating a community. A community can include networks, but in our opinion, the community is a somewhat 'looser' concept. A community involves informal contact between employees, meeting each other at seminars, organising sports competitions, concerts, etc., all in a well-designed environment that promotes creativity.

Campusses and non-campusses

The relationship between a science park and a university was briefly discussed above. However, a science park can also develop around another important knowledge institution; even a company can be the linchpin. In the latter case, it is better to speak of an (industrial) co-innovation park. Whereas the crystallisation point in a science park is a university, in a co-innovation park it is a leading industrial company. Examples in The Netherlands are the Biotech Campus Delft (DSM), the Chemelot Campus (DSM, Sittard/Geleen) or the Novio Tech Campus (NXP, Nijmegen). The High Tech Campus in Eindhoven can also be described as a co-innovation park, as it originated around the Philips NatLab. The co-innovation park focuses on cooperation (co-innovation) between the leading company and other companies and institutions established or to be found around this company.

In addition to these industrial co-innovation parks, all of which bear the name campus, many other ‘campuses’ have developed in The Netherlands in recent years. However, these are campuses where there is little or no exchange of knowledge or co-innovation. It leads to a devaluation of the concept, for the sake of - in our eyes - cheap and little creative marketing. This broad interpretation of the concept seems typical of The Netherlands. Dutch marketers, real estate developers and municipalities have more or less given it their meaning. Abroad the term is first and foremost used for a university campus, usually with accommodation for students and staff.

In The Netherlands, due to unclear circumstances - or it must have been marketing - the term campus has more or less coincided with a science park. However, it is questionable whether, for example, the Dairy Campus (meeting place for the dairy industry), KNVB campus (sports training) and, more recently, a campus for the development of financial technology, are at the heart of the idea. If we are going to call every development a campus, how is it to be clear to the outsider that this is a development that is focused on innovation? So, we want to see the term reserved for serious, innovation-oriented developments, if used at all.

Figure 1: Novio Tech Campus, Nijmegen, The Netherlands. An example of an industrial co-innovation park

Working environment

While during the emergence of science parks the emphasis was often on physical development, people involved have gradually come to realise that science parks require a completely different approach. About two decades ago, the adage 'brains, no bricks' was introduced. This was opposed to a science park as purely a real estate development. This change in thinking does not alter the fact that the built environment is still vital to stimulate the process of creativity, interaction and innovation (Van Dinteren & Keeris, 2014). The importance of this is even increasing, now that people realise that an attractive (physical) working environment contributes to creativity and competitiveness. In this respect, we could make a distinction between facilities for employees and facilities for companies.

The sharing of facilities for companies, with which one also hopes for knowledge sharing and synergy, is an important reason why companies establish themselves in a co-innovation park or science park. Even more important than the actual possibilities for collaboration with the university itself, according to research

among entrepreneurs established in Dutch science parks. In addition to the presence of a young student population, the availability of information systems, laboratories and clean rooms play a role (see chapter 3).

When it comes to facilities for employees (including the ambience created by buildings, building design and 'landscaping'), management follows the following line of reasoning: if employees enjoy their work, they work better. And if they work better, it has positive effects on productivity and creativity. Ultimately, this leads to better results for the company. More than two-thirds of the entrepreneurs in Dutch science parks agree (entirely) with the statement that "given the increasing shortage on the labour market for highly educated people, a science park must offer an optimal working environment" (Van Dinteren & Pfaff, 2011). Such an environment involves extensive facilities (such as shops, a hairdresser, catering or fitness) and an attractively designed park with recreational facilities (such as walking and running routes, and meeting places). A concept such as Enjoy Work is therefore not primarily about the target group, but about creating such a stimulating working climate (see www.enjoy-work.com; Van Dinteren, 2007).

Figure 2: a high quality work environment (Future Campus, University College Dublin. A project by UNStudio)

New developments: economies of scale

The science park concept is not static. Given the nature of the activities and institutions, it focuses on, that is not to be expected either. Whereas until the beginning of this century the concept was mainly seen as a standalone activity and often primarily as property development, today the science park is much more seen as a concentration point in an innovative region. As a result, more attention is now being paid to the embedding of the park in its region. This also

emphasises the importance of the development of regional knowledge networks between the science park and solitary companies and knowledge institutions. As science parks came up against the limits of growth, 'branches' were often developed elsewhere in the region, which further emphasised the regional networking. Among the members of the IASP, one in three has two or more locations. We see similar trends in The Netherlands. Utrecht Science Park has a satellite location in Bilthoven, which has a different owner. Campus Groningen is the umbrella term for the Zernike Science Park and the Healthy Ageing Campus (around the University Medical Center Groningen). Consideration is also being given, for example, to the possibilities of better linking, coordinating and promoting activities in the field of life sciences (individual companies; science parks) on the Oss/Schaijk-Nijmegen-Boxmeer axis.

In light of this same process of scaling up, the concept of innovation area has emerged in recent years as an indication of an innovation-oriented region. To avoid ambiguity in terminology, we reserve the designation ‘innovation area’ as an umbrella term for science parks, co-innovation parks and innovation districts (see below). We prefer to refer to an innovative region as an innovation-oriented region. In such a region, various crystallisation points can usually be found like industrial co-innovation parks and science parks. Above all, it is essential that here, too, there is overarching management. Amata Science City in Thailand and Ann Arbor SPARK in the United States are examples of this on a regional scale (more about management in chapter 7).

New developments: innovation districts

In addition to co-innovation parks and science parks, innovation districts have attracted a great deal of attention in recent years. Initially, the development seems to have taken off, particularly in the United States. With a small adjustment, we use the definition of Sanz (2016) for an innovation area for that of an innovation district: "A designated zone with its own specific management team, whose main objectives include economic development via the promotion and attraction of selective innovative business for which specific services are provided or made available, and that may also include residential and cultural zones or facilities, or be embedded in urban spaces having such facilities, and with which the economic aspects of the area of innovation interact.”
As with the other concepts, in an innovation district, management is of great importance, but function mixing is a relatively new element here. The link with a university may be less intense but can be partially overcome by an annexe (see also chapter 6). A well-known example is the Boston Innovation District, which has a surface area of approximately 150 ha (see Rodriguez, 2015). Interesting is the possibility of such a development coinciding with the redevelopment of a neighbourhood or district. Boston and 22@Barcelona are striking examples. The innovation district will not replace the science park. It should be seen as a new concept, alongside that of the science park and the industrial co-innovation park.

Figure 3: the redevelopment of the area around the railway station of Eindhoven (The Netherlands) can be considered as an innovation district (a project by KCAP Architects&Planners)

Evolution of area management

Whereas initially the management placed a strong emphasis on the care for real estate, this accent was soon combined with the provision of services and facilities, which in turn was followed by the desire to create a business network in the science park (or broader: the area of innovation). Matchmaking, seminars and support with patent applications are matters we see in the basic service package of the extensive management. The next step - again: in an ideal-typical process - is to connect not only the companies and institutions but also the people working in the innovation area.

How management actually takes shape varies considerably; there is no particular model. It seems that each innovation area has its variant. The chosen form is highly dependent on the parties involved and the chosen emphases. To start with those accents: broadly speaking, this means a distinction in infrastructure, buildings and facilities, as well as non-physical matters such as community building, networking and so on. This variety of tasks requires employees in the management team from very different backgrounds.
When we look at the parties involved, local authorities, universities and private (real estate) parties come into the picture the most (European Commission, 2014; see also European Commission, 2020). This can, for example, lead to a joint venture between a university and an investor, as was initially the case with the Oxford Science Park. The area management team is small in size, has specific experts and mainly outsources tasks. The Surrey Research Park (UK) is entirely in the hands of the university, which started the development financially, by first selling a large plot of land to a big, leading company (after which everything was

leased out). The management here is divided into three departments: one for real estate, another for technology transfer and business management (the networks), and a more general department that focuses on planning, marketing, admission policy and financial management.

What experiences have taught us

Different types of innovation areas can contribute to a region's innovative strength. Experience with the development and management of science parks and co-innovation parks makes it clear that success depends on several strict conditions (see chapter 2). A close assessment of all kinds of ideas and developments, which are now, or will be, marketed mainly in The Netherlands under the name of ‘campus’, will probably show that many of these initiatives do not meet these conditions. Too often this is an unrealistic, unsubstantiated dream of a mayor or alderman, who later leaves the community with high costs.

We would also like to remind you that, unlike the development of a regular business park, most of the activities of the management of an innovation area do not stop after the issuance phase. This management is crucial in the exploitation phase of innovation areas. Today, park management that only looks at real estate and asset management is entirely off the mark. Innovation areas explicitly call for the development of a community of employees and the creation of networks between companies and institutions. The trick is to combine these 'soft' elements with the 'hard' side of real estate (see chapter 7, which deals in more detail with the management of areas of innovation).

In the last decades, the financing of that property has not been able to count directly on warm interest from the financial sector, both in terms of construction financing and the loan capital to be contributed. Because of the return or risk profile of R&D-related real estate and in comparison, with other real estate investment categories, this reluctance is unjustified. This real estate segment is struggling - partly due to a lack of useful statistics - with the phenomenon of 'unknown makes unloved' (Van Dinteren & Keeris, 2014). In recent years, however, we have seen parties entering the market who see investing in innovation areas as a serious and attractive business.

In conclusion

In conclusion, against the background of the changes outlined, we want to state that the older generation of science parks requires redevelopment, with more emphasis on networking and community. Furthermore, we need to look at how the physical environment can be restructured to promote this social dimension (see chapter 4).

For their part, new parks and districts will have to find a good combination of hard and soft factors from the outset. They must be embedded in the regional economy, be part of wide-ranging innovation programmes and be managed,

based on integrated management philosophy. And all this in an attractive spatial setting with real estate, which optimally facilitates this new way of working.

IADP in the picture

IADP Autumn Seminar, 2017

IASP World Conference, 2019

IADP excursion to Reading and London, 2019

2. Success factors

Innovation is the keyword in government plans to strengthen the economic climate. Numerous conditions will have to be created for a successful innovation policy. What cannot be overlooked in this process is the specific environment that businesses require to be able to work on new ideas, products and services successfully. Areas of innovation can provide such an environment. The development of areas of innovation is many times more complex than the development of a regular business park. Therefore, the development of such areas calls for a well-grounded integrated plan. It also requires clear ideas for, among others, park management, financing, guidelines for buildings, property financing.

Given the importance of innovation areas in supporting economic development, these areas are given due attention in research. This research will make it possible to identify success factors. Based on papers presented at various IASP conferences (International Association of Science Parks and Areas of Innovation), we have drawn up the first list in 2015 (https://www.linkedin.com/pulse/success-factors-science-parks-jacques-van-dinteren/). More research is now available and sometimes the success factors themselves are also the subject of research (see for example Faria c.s., 2019; Jansz c.s., 2019; Pancholi c.s., 2015; Poonjan c.s. 2019; Weng c.s.; 2019). These new publications provide the opportunity to refine and expand the list made previously. Once again, we make a distinction between regional factors and factors relating to the development itself. The focus here is limited to science parks.

Success factors: regional conditions

As mentioned earlier in chapter 1, there is a clear relationship between a region and a science park. It is impossible for a science park (or any other type of innovation area) to get off the ground or function properly if certain regional conditions are not met. Important conditions on a regional scale are:

- Incorporated in a national innovation policy.
- The presence of tertiary education, universities and other research institutes.
- Entrepreneurial culture.
- A well-functioning network of innovative/creative businesses and institutions.
- Industrial structure.
- A well-functioning labour market of knowledge workers.
- An attractive residential and living environment.
- The degree of urbanisation.
- Available sources of financing.

Incorporated in a national innovation policy
Proper interaction between the region (regional government) and the national government can influence success, partly because it is a form of recognition of the potential present in the area.

Figure 4: the Hoa Lac National Innovation Centre in Vietnam is directly linked with the national strategy on Industry 4.0. to create a world-class technology start-up ecosystem in Vietnam (a project by Arup)

Entrepreneurial culture
Cultural aspects partly determine the innovative strength of a region. Perhaps because this is difficult to investigate or prove, researchers limit themselves to mentioning characteristics such as (mutual) trust, creativity, focus on cooperation and innovation. The region needs to 'buzz and bubble'. In The Netherlands, regions such as Rotterdam and Eindhoven often already have such a profile. It sometimes leads to notable developments such as the Brainport Industry Campus in Eindhoven; a concept that originated from the manufacturing industry itself.

The presence of tertiary education, universities and other research institutes
Research shows that successfully establishing strong partnerships with university scientists leads to higher performance levels of science parks and more generally of innovation areas. This interaction is often mentioned, but it should be remembered that universities are also the 'suppliers' of highly skilled workers and have research equipment that can be used by third parties under certain conditions. A university that functions as an 'entrepreneurial university' is generally highly valued.

A well-functioning network of innovative/creative businesses and institutions
A reliable network of companies and research institutions is a frequently mentioned regional condition in the research literature and a unique aspect of

the aforementioned entrepreneurial culture. Strong, specialised economies with an excellent regional or local innovative ecosystem form a strong basis for prosperous areas of innovation. Think of Dutch examples such as Foodvalley (Ede - Wageningen region) and Life Cooperative (in Groningen). An example where a regional branch of a financial institute took the initiative is RvN@ in the Nijmegen region.

Industrial structure
The industrial structure of a region must also be considered. After all, different industries have varying degrees of innovation orientation. The already existing regional industrial system is a common theme in research papers on success factors. The importance of a robust technological base is usually mentioned in the first place.

A well-functioning labour market of knowledge workers
Technology and knowledge companies and institutions depend even more than other economic sectors on well-educated, creative workers. The region must be able to attract and retain these knowledge workers.

An attractive residential and living environment
An attractive residential and living environment is an essential condition for attracting highly educated employees and retaining knowledge workers already living in the area.

Degree of urbanisation
Large, diverse, metropolitan regions in established developed economies are one of the key factors influencing the success of science parks and other areas of innovation because of easy access to skilled human labour, financial investment, support institutions, face-to-face meetings and so on. The so-called conurbation benefits or economies of scale.

Available sources of financing
Innovative companies often need a long development period for their products. This requires, among other things, specific financial arrangements from cooperating financial institutions and access to other sources of funding, such as innovation funds. Availability of financial support is vital for the performance of companies and institutions located in innovation areas. In addition to a government grant and investment funds, regional development entities or business angels can be considered. However, there is still a lot to be gained in terms of cooperation between different financial parties (pooling of strengths; risk diversification).

Success factors at the science park level

It will be apparent that the developer or manager of a science park will usually have little influence on the regional factors mentioned above. Cooperation with local and regional authorities is therefore obvious. On the other hand, the

manager/developer has more power (if not decisive) in the science park itself. Firstly, we list the success factors and will then detail the main themes.

The key success factors for the science park itself are:
- Good embedding of the park in local or regional economic policy.
- Thorough market research, resulting in an appealing concept and a long-term strategy with a flexible development framework.
- A clear profile:
    - > clear distinguishing concept, profiling, target group (degree of mixing of functions), admission strategy;
    - > presence of anchor companies or institutions.
- Attractive, target-group-focused design:
    - > the scale of development;
    - > quality of physical infrastructure (including communication networks);
    - > attractive design/landscaping, including a variety of meeting places;
    - > high-quality architecture.
- Good service infrastructure for companies:
    - > a strong mutual network of companies and institutions;
    - > targeted advisory services;
    - > shared facilities;
    - > business-oriented events;
    - > embedding in regional and (inter)national innovation networks.
- Creativity stimulating working environment:
    - > provisions for employees;
    - > events.
- Strong management organisation.

Embedding in regional policy

The development of a science park (or any other type of innovation area) must be explicitly embedded in a regional or local innovation strategy to promote economic growth. One of the reasons is - as mentioned earlier - that a science park is not a stand-alone development. Established businesses are interlinked, but they also have links with the region and more distant areas. A region with several interconnected innovation areas can have an added value. Think, for example, of Ann Arbor SPARK in the United States of America or the connected science parks in Heidelberg (Germany).

Market, concept and long-term strategy

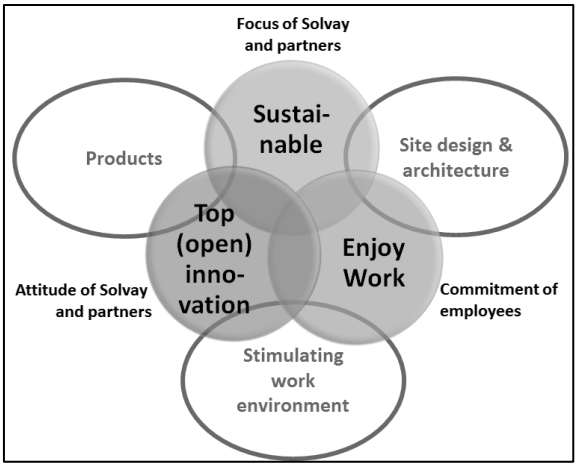
One must base the development of a science park on sound market research. Based on this research, the target group can be demarcated, and a distinctive concept can be devised (figure 5). This must be laid down in a clear vision and a (flexible) long-term strategy to achieve the formulated goals. Because a specific target group is chosen, it should be taken into account that the development time is longer than in a more traditional development, such as a business park.

A clear profile

A clear choice for one or more target groups is the basis for a clear profile. The management is responsible for a strict admission strategy and must adhere to it. Such a policy has consequences for the turnaround time and therefore for the financial exploitation. Managers of science parks and innovation areas around the world give the impression of following a severe admission strategy. 'Focusing on innovation' is the most popular admission requirement. 'Technological orientation' is the second most common answer. Nevertheless, research on eight science parks in the Netherlands showed that on average only 33% of the companies on these science parks were targeted (see chapter 3 for the details).

In addition to the target group, there may be room for complementary companies, such as consultancies and other specific (technical) service providers.

Figure 5: a functional concept for the Solvay industrial co-innovation park, Brussels (Zjak Consult, Caudata)



Certainly, in the start-up phase, having an anchor tenant can have a positive effect on attracting other companies and institutions.

After making a clear choice in terms of target group and real estate concept, management and stakeholders must then ensure that the science park has a clear identity. This identity, for example, is elaborated in the name and logo and must be expressed distinctly and consistently externally by all parties involved.

Another point to consider when choosing a target group is the following. The trends also include the increasing interest of companies in crossovers, with entrepreneurs assuming that this leads to (better) innovations and better business results. This largely abandons the idea that innovations come about in a specialised cluster of companies. On the other hand, the idea of crossovers does not indicate a complete abandonment of an admission policy. On the contrary,

companies and institutions should be selected based on another criterion, namely having a so-called common knowledge base. The keyword here is 'related variety'. This concept assumes that regions and also science parks can benefit from producing a variety of products and services since more variety implies more potential for knowledge dissemination between industries. Knowledge from one sector is most relevant to and can best be absorbed by another industry that is related in the sense that companies use similar knowledge (about technology, markets, etc.). In this case, the regional setting should also be taken into account, as relations between companies and institutions are never limited to the science park itself.

Figure 6: Utrecht Science Park Bilthoven, The Netherlands, has a clear identity due to its strong focus on the entire vaccination chain (a project by Arup, Caudata, Karres en Brands, Proof of the sum and Zjak Consult)

An attractive design, aimed at the target group

This concerns the scale of the development, the quality of the physical infrastructure, the layout of the public space, and urban planning and architecture.

The scale of a development will influence the effect. The larger the park, the more companies and institutions can be accommodated and the more opportunities for interaction. Moreover, a large area offers more support for additional functions, and even a mix with housing can be a consideration (see chapter 4).

The infrastructure must be up-to-date, and the communication infrastructure must be state-of-the-art. Infrastructure also includes access to the science park. Due to the often-peripheral location of science parks on the outskirts of cities, car

use is generally high. In English science parks, for example, we are now seeing increasing interest in improving public transport, and science park owners are also investing in this.

There should also be an overarching urban development concept and a coordinating urban planner who supervises the architecture of the individual buildings. Because of long-term planning, flexibility in the concept is crucial. Nowadays, sustainability plays an essential role in all plans.

Research has also shown the positive effect of landscape architecture on the mood of workers. Semi-natural, not too formally designed areas are particularly appreciated. Attractive landscaping can be combined with informal meeting places, fitness areas, etc. It also goes hand in hand, of course, with objectives relating to sustainable development. Green Park in Reading (UK) is an excellent example of sustainability combined with landscaping.

Renting out buildings by a single owner (or a minimum number), combined with tradable or flexible leases and competent property management, offers companies many growth opportunities on a science park.

Services for companies and institutions
Although no weight can be given to the various success factors, available services for companies and institutions may be an exception. Indeed, many researchers stress the importance of excellent facilities, especially sharing them. Facility sharing (including opportunities for knowledge sharing and synergy) is the reason why companies establish themselves in a science park. This factor is even more important than cooperation with the university, research among entrepreneurs based on Dutch science parks shows. These entrepreneurs also stressed the importance of the availability of information systems, laboratories and clean rooms. At a somewhat lower level, but still very much appreciated, are catering, meeting rooms and restaurants (see chapter 3).

From an organisational point of view, there are two main options here, which will often co-exist. Firstly, private parties will take the lead. Think for example of Igluu OneSpace and Igluu DaySpace (office space). At Oxford Science Park you can rent laboratory space by the hour. Also, it is precisely the organisation around the sharing of facilities (the management as an intermediary) and possibly the development and management of these facilities that is a task for science park management.

Creativity stimulating working environment
In addition to the facilities for companies, there is increasing recognition of the importance of a good working climate for employees. Established companies and institutions have an essential role to play here, but the overall management certainly also has to be involved. More than two-thirds of the entrepreneurs based on Dutch science parks agree (entirely) with the statement that, "because

of the increasing shortage on the labour market for highly educated people, a science park must offer an optimal working environment". Such an environment involves extensive facilities (such as shops, a hairdresser, catering or fitness) and an attractively designed park with recreational facilities (such as walking and running routes, and meeting places). A concept such as Enjoy Work (Chiswick Park, London) is therefore not primarily about the target group, but about creating such a stimulating working environment. First of all, it is striking that the management of Chiswick Park mainly consists of people with hotel management training. In addition to facilities such as sports facilities, a range of services and a shopping service on the intranet, courses can also be followed at the end of the day, for example, and there are numerous events.

Spatial clustering of these services, together with a ban on own catering facilities and large meeting rooms, has led to a lively movement of people at the High Tech Campus in Eindhoven (The Netherlands). Such dynamism improves the quality of life and can lead to unexpected encounters.

The essential role of science park management

It has already been pointed out that a science park is distinguished from the development of a common working area by the strong emphasis placed on management. This distinction is first and foremost due to the idea behind a science park: to promote networking and interaction. With the latter, a distinction can be made between companies and institutions on the one hand and employees on the other. Two perspectives can then be distinguished in campus management, which in turn can be further subdivided:

- Area management (the physical area):
    - real estate;
    - public space.
- Ecosystem management (socio-spatial system of relations and activities):
    - network management (aimed at companies and institutions, including the provision of associated facilities, matchmaking, seminars, support with financing and patent applications, etc.);
    - community management (focused on employees; concerns facilities and events).

There are many ways to manage a business, and there are also many ways to run an innovation area (see chapter 7). When analysing management concepts, ownership is an important starting point. A survey by IASP in 2012 shows that the public sector dominates: public parties, mainly local authorities, public universities and regional authorities own 55% of science parks in Europe. The owner can be a single party, but also an alliance of these public parties. 15% of the science parks are privately owned (private universities and foundations and private companies) and 31% have mixed ownership. In the latter case, local government, public universities and private companies dominate.

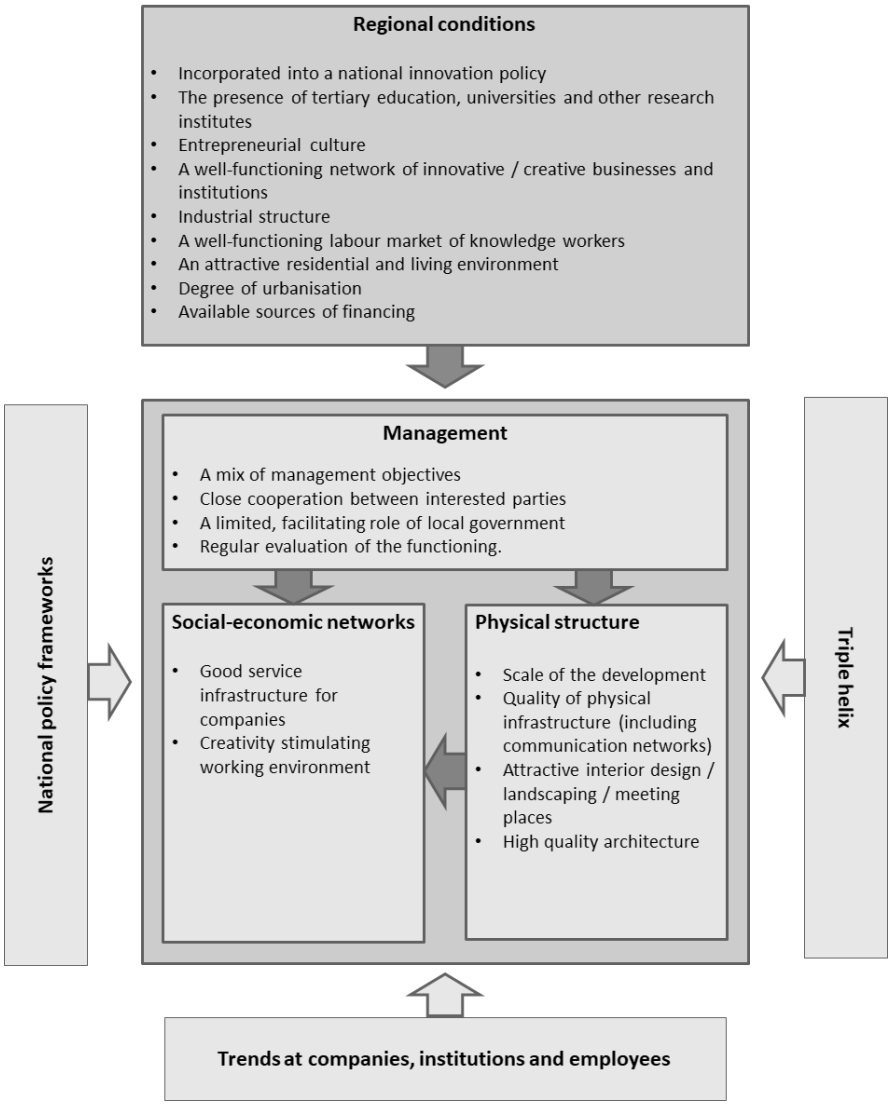
Generally, a modest attitude on the part of local government is seen as a factor for success. Indeed, the setting up and management of a science park requires very specific knowledge which is usually not present in a municipality. Moreover, there is a risk that a local authority with financial interests in science park development will be more willing to abandon the concept or make concessions than other parties involved if the land issue does not proceed at the desired pace. Hence the comment made earlier about the importance of more extended exploitation periods. On the other hand, the local government is the ideal partner in the policy of creating conditions.

Finally, it can be noted that the activities of management are seldom evaluated. Such an evaluation can best be done by approaching established companies and institutions once every two years with a survey, whether or not combined with work sessions and in-depth interviews. An external party can best do this. Such an evaluation can provide a lot of valuable information that leads to adjustments in the set-up of the science park and its management.

Essential success factors in the management of a science park are then:
- A mix of management objectives, looking at both the physical aspects and the socio-spatial aspects, the latter distinguishing between the companies & institutions and the employees.
- Close cooperation between the parties concerned.
- A limited, facilitating role for local government.
- A regular evaluation of the functioning of the science park through research among companies, institutions and employees.

The following figure summarises the success factors.

Figure 7: success factors



3. Science parks: stimulating innovation or just iconic for firms? [2]

Science parks can play a significant role in our knowledge or network economy as focal points for R&D and innovation within a highly innovative region. The firms and organisations established in these parks are the key players in this development, and their role seems seldom be questioned. Nevertheless, as science parks often have a well-designed environment and have high-quality buildings, one could suppose that it can attract firms that are very much interested in the appeal of the park. Being established in a science park is quite different from having an establishment in some industrial estate and will undoubtedly have an impact on the image of the firm. Some literature touches the subject incidentally. Löfsten and Lindelöf (2002) cite two studies by Monck et al. (1988) and Westhead and Storey (1992). They claim that some firms have moved to science parks because of the image and overall prestige of the site, rather because of access to facilities of the higher education institute or centre of research and the stature of being linked to this institute or centre of research. Ferguson and Olofsson (2004) studied differences between new technology-based firms on and off two Swedish science parks. They concluded that the image associated with a science park location does not help explain growth, whereas a site with cooperation with universities is positively associated with growth. A study of Spanish science parks led to a typology of firms (Molas Gallart, 2009). The first type only exploits the real estate services provided by the science park, "benefiting from the image and physical infrastructure endowed by their location." This also seems the case for Type II firms. Unfortunately, there is no information about the relative size of these groups.

The previous is not meant to argue that the image of a science park does not matter. As in the case of any 'product', image matters to attract (in this case) highly innovative firms and research organisations. The attraction factor is not restricted to the built environment: "An image of success plays a key role in attracting tenants, talented people to work for the tenants and in building local support and understanding of the park's activities" (Dabrowska, 2011). But if it is only about the image, the primary goals of a science park are not realised.

Based on an exploratory study at six Dutch science parks (see also Van Dinteren, 2009), this chapter presents an initial picture of the characteristics of the science park concept and attempts to evaluate its significance. The following parks are

[2] Previously released by Jacques van Dinteren as a paper for the 41st Annual Conference of Regional Science Association International, British and Irish Section, Galway, Ireland, August 2012.

involved in the study: the Bio Science Park (Leiden), the High Tech Campus (Eindhoven), the Mercator Science Park (Nijmegen), the Zernike Science Park (Groningen), the Amsterdam Science Park and the Business & Science Park in Enschede. In total, we have received 134 usable questionnaires. The response varied by park from 20% to 43%. Weighted for the number of companies, that comes to an average of 27%. Not an exceptionally high percentage, but unfortunately characteristic of written questionnaires in companies nowadays. The level of significance maintained in this research is 5%.

Table 1: comparison of the statements concerning knowledge productivity and image

	Proposition on image				
Proposition on knowledge productivity					
	Completely disagree	Disagree	Agree	Completely agree	Total
Completely disagree	0	11	12	35	15
Disagree	20	18	49	40	37
Agree	20	63	39	15	41
Completely agree	60	8	0	10	6
Total	100	100	100	100	100

Image versus knowledge

Let us begin not with facts but with opinions. In the survey, we presented the companies some propositions. For two of these, a striking contrast arose, almost a complete difference of opinion. We will first take a look at these two propositions. Of the companies, 47% (completely) agree with the statement, “Because of the presence of companies and knowledge institutions directly around our company, the knowledge productivity in our company is considerably higher than in another location.” However, 65% of companies also (totally) agree with the following statement: “In practice, a science park does not really turn out to offer our company a great deal in terms of relations with knowledge institutions and other businesses. But it is definitely a good way of making our company known (marketing; image).”

There is a strong negative relationship between the scores for these two statements. Of the respondents who (completely) disagree with the proposition that setting up in a science park does not provide many advantages in the area of knowledge productivity but is good for the company's image, 80% (completely) agrees with the proposition that knowledge productivity is much higher in a science park than outside (table 1). This relationship can also be found the other way around. Choosing a science park for reasons of image seldom goes together with choosing a science park because of the (expected) increased knowledge productivity.
If we now divide the population into four subgroups, as indicated with the colours in table 1, some interesting differences come to light. We describe the four groups as knowledge seekers (positive about knowledge productivity; attach no importance to image), image builders (the opposite view), the mixed group (find image important, but also experience higher knowledge productivity) and the indifferent group (at least where these two aspects are concerned). The combination of attaching importance to knowledge production and the image does not occur that often: the mixed group has a small share of 9%. The largest group is that of the image builders (43%). The other two subgroups have practically the same percentage: 25% of respondents are counted among the knowledge seekers and 23% among the indifferent.

Aspects related to the place of business

In the questionnaire, a distinction is made between reasons for choosing the location at a regional level and those for setting up in the science park itself. Looking at the reasons for choosing the region, the companies were allowed to indicate the three most important factors. The closeness of the university and/or knowledge institutions scored highly (20%), followed by the more traditional factors such as geographical location (15%), easy accessibility (14%) and "historically developed like that" (13%). Only then comes a factor that can be related to knowledge and innovation: the availability of highly trained staff (8%).

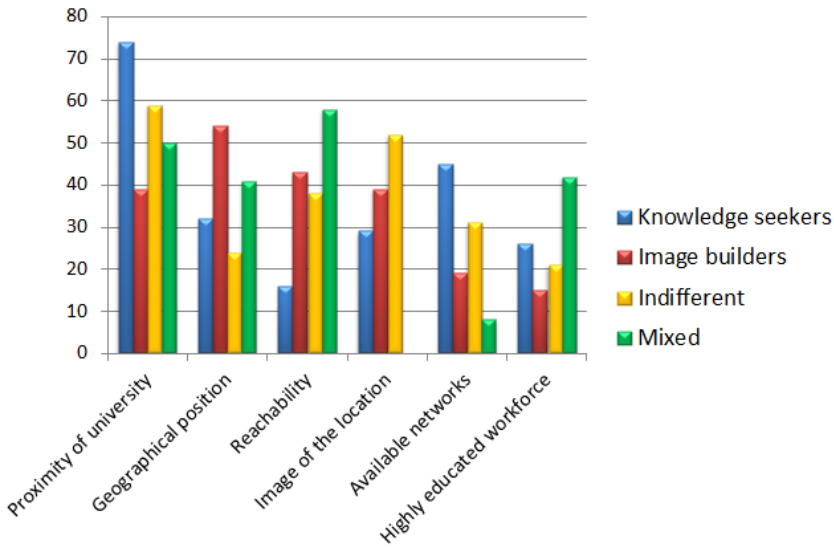
Among the most critical factors for their choice of location in terms of the actual science park, from the companies' point of view, two specifically 'science-park aspects' score relatively highly. These are, in the first place, the presence of other companies and/or knowledge institutions (21%) and the available networks of companies and knowledge institutions (12%). Here, too, the more traditional factors such as the location's image (16%), the availability of a representative building (14%) and the rent and service costs (11%) feature high in the list.

If we look at the different aspects concerning the chosen place of business for the four different subgroups, then we can observe significant differences for six factors (figure 8). Unsurprisingly, the closeness of a university is of above-average importance to the knowledge seekers. The presence of networks between companies and institutions is also considered to be important by this group. Conversely, for the image builders, the geographical location is essential,

as is the accessibility and, as might be expected, the location's image. The aspect 'representative building' though shows no significant differences. Accessibility counts as well for the 'indifferent' companies, and this group also sees the location's image as (very) important.

It is above all the knowledge seekers who emphasise the aspects connected with a science park, although the firms in the mixed group even consider the availability of higher educated personnel of greater importance than the knowledge seekers. The other groups attach more value to more 'regular' factors.

Figure 8: differences in the evaluation of factors in choosing a place of business (the percentage that finds the aspect in question important or very important)



Significance of the university for the companies

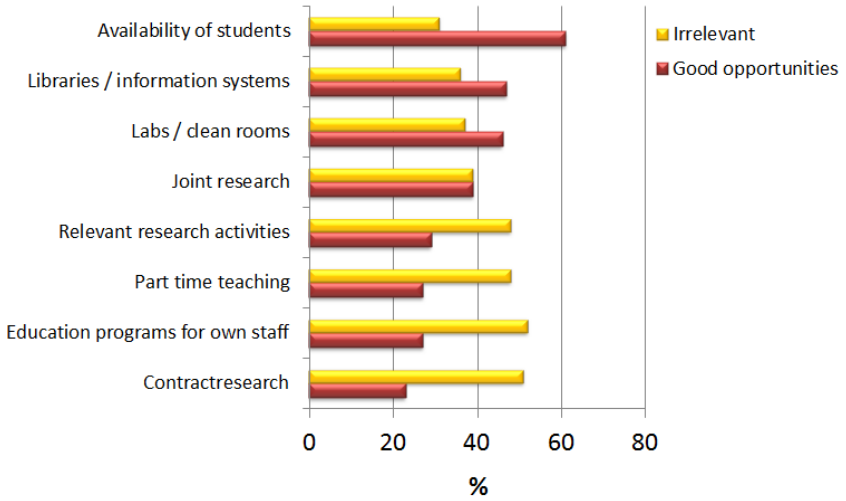
A science park is generally associated with the presence of a university. In the cases studied here, the universities – except for Eindhoven – can be found in or next to the park. The fact that the university is so close is not a rule, since for science parks worldwide the university is located in or in the direct vicinity of the science park in only about 40% of the cases.

Of the companies in the study population, a third works together with the neighbouring university in the area of R&D. The differences between the company groupings highlighted here are substantial. Unsurprisingly, the proportion is highest among the knowledge seekers (55%), followed by the 'indifferent' with 38%. In the small group that chose both knowledge productivity and image, the proportion is 25%. Only 18% of the image builders collaborate in

any way with the university in the field of R&D. The partnerships are usually strong and are generally formal.

The study asks about the opportunities that a university can offer the company operating in a science park. For many of the elements given, the companies indicate that these are not relevant to them. Depending on the different possibilities, around 30 to 50% indicate that they are irrelevant for them (figure 9). That applies particularly to contract research and teaching at the university. For many companies, it is also not very important that all sorts of research activities take place nearby universities or that their employees may be offered academic programmes.

Figure 9: assessment of the opportunities from the neighbouring university



If we examine the companies for which certain aspects are relevant (figure 9), then the most important are the availability of graduate students, the access to libraries and data systems, and the access to laboratories and clean rooms. Only after that come the aspects more directly associated with research such as the opportunities for joint research between the company and the university and the presence of relevant research activities.

Given the idea of what a science park is (or ought to be), one could assume that the latter aspects, such as contract research, would achieve much higher scores. Here, too, the picture becomes more apparent when we examine the four subgroups. If we look at the knowledge seekers, these show above-average scores concerning the appreciation of research activities (relevant to the company) present in the university (96% against 74% overall), of being able to carry out joint research (89% against 73%) and of the available laboratories / clean rooms (72% against 51% of the total population). The ‘indifferent’ group is also clearly

interested in the university. Being able to collaborate on research scores positively with this group (90% against 73% overall). The other two significantly higher scoring items concern the 'training side' in particular: the possibility of academic programmes for employees (88% against 57%) and the opportunity as a company to provide classes in the university (74% against 47%). As this is the group that is indifferent to the idea of 'knowledge production' (and also of image), you would not expect this. One might suspect that start-up companies are involved here, but there was no significant connection to be found.

Innovation in the companies in science parks

It may well be that a part of the population finds image more important than knowledge productivity, but that does not alter the fact that the information obtained shows that in the science parks concerned the necessary activities take place in the field of R&D and innovation. Of the companies in the study population, 26% spends nothing on R&D, but for most of the companies R&D expenditure is greater than the norm for an average company. The average comes out at 29%, the median at 13%. If we again separate the results into the four subgroups of companies, we see that in the knowledge seekers almost three-quarters of the companies spend 11% or more of their gross revenue on R&D. The mixed group is the weakest in this aspect (table 2).

Table 2: the percentage of gross revenue spent on Research & Development

	Knowledge seekers	Image builders	Indif-ferent	Mixed	Total
0-3%	7	26	17	33	20
3– 10%	19	33	48	42	34
11 – 40%	35	24	24	0	25
> 40%	39	17	10	25	21
Total	100	100	100	100	100

Activity in the field of R&D must lead to innovations: new products, services or processes. Patent applications (and, further, obtaining patents) are one of the consequences of this. Table 3 gives an outline of these aspects. Notably here the knowledge seekers prove to score remarkably high in comparison with the rest of the population. What is also striking is that, after we have already seen earlier that the 'indifferent' attach greater than average importance to being able to carry out joint research with the universities, they now also have an above-average score regarding collaboration with other companies. The mixed group also scores well in this regard. It is – unsurprisingly – the image builders who score differently in a negative sense.

Table 3: the percentage of gross revenue spent on Research & Development

	Knowledge seekers	Image builders	Indif-ferent	Mixed	Total
Works together with other companies in the park	55	24	45	42	38
Brought out a new product in the past five years	71	33	30	14	39
Brought out a new service in the past five years	59	41	55	43	48 (NS)
Brought out a new process in the past five years	12	13	5	0	10 (NS)
One or more patents applied for in the past five years	32	14	18	20	20
One or more patents granted in the past five years	29	11	18	20	22

NS: not significant

Conclusion

Science parks are intended to create an environment for businesses and knowledge institutions in which they can function well by making use of each other's facilities, and where they can meet each other informally and exchange knowledge. The fact that they can also be seen as an attractive work environment is a plus point for the critical knowledge worker, just as the presence of a young student population can be appealing to businesses. That is the concept. Strategic partnerships and the exchange of (strategic) knowledge are no part of that. Such things are so important that people are ready to travel across the whole world for them; it is not something that happens somewhere within the confines of a science park (Van Dinteren, 2007, 2009). That is not to say that interaction does not matter. Creating a community on a science park is an important management task.

If we take a look at the results of this analysis, it seems possible to establish, based on the answers from the companies, that in the Dutch science parks the above points are met. There is an above-average investment in R&D and there are collaborations between companies and the university and among the companies – even if this only applies to a third of the cases. So by and large, the opportunities are there, but it is only a limited number of the businesses that make use of them. Undoubtedly this has to do with the fact that a large group of companies can be found (almost half) in the science parks that first and foremost

attach importance to the allure of the science park and above all to its effect on their image.

The general conclusion appears to be that science parks in the Netherlands are set up in such a way that they can fulfil the concept of a 'science park', but the admission strategy lacks cohesion (see also Westhead, 1997). There is no critical consideration of the companies that put themselves forward. Given that most science parks are limited in size, the risk exists that the power of the concept is undermined through this. To conclude, we invite you to consider the following quote from David Adamson (director of Estate Management, Cambridge University): 'If someone rang and said, "I want to put up a 10,000 sq m building," I would ask which professors they are working with. If they couldn't answer the question, I'd tell them to go to one of the colleges. It's not an open season science park. You have to demonstrate links with the university to be here' (Van Dinteren, 2007).

Figure 10: High Tech Campus, Eindhoven, The Netherlands

4. Considerations for science parks to remain competitive [3]

Disruptive technologies and new developments such as robotics, virtual reality, the 'Internet of Things' and artificial intelligence are changing the way people live and work. These changes have such an impact that one speaks of the fourth industrial revolution era (Schwab, 2017). This era stresses the importance of geographical areas of innovation where companies and institutions find the right conditions to be creative and to attract the (often scarce) workforce they are looking for. Although information is shared worldwide, local networks are still vital and even seem to be gaining in importance. Spatial clustering makes it easier to get access to information, to collaborate, to use particular services and to create an environment that stimulates creativity and well-being.

The innovation district is a relatively new concept. It might be a competitor, especially for science parks, as the innovation district often seems to be a better answer to changing demand by the management of innovative companies, and knowledge workers, especially the young ones. This is not to say that the science park will be less successful, and companies and institutions might choose other options. If only because some companies have specific space requirements or possible environmental impacts that make them unsuitable for city-centre locations.

We can consider innovation districts and science parks as different segments in the market of innovation areas. Nevertheless, science parks have to adapt to new requirements by their clients. Even if no innovation district is available in the region, managers of a science park have to interrogate the qualities of their park. Several science parks are already adjusting their existing plans in such a way that a more multifunctional, innovation-oriented living and working area is created. Examples are the plans for the Sydney Science Park (Australia) and Lindholmen Science Park in Gothenburg (Sweden). In The Netherlands, Kennispark Twente could be moving in the same direction, given the strategy that has recently been presented.

In this chapter, we will focus on what opportunities science parks have to remain competitive in the new era. We first analyse the innovation district as an assumed competitor of science parks. The attention paid to this new development suggests that it fits much better with today's demand by the innovative industry. Based on that analysis, we will present three considerations management of science parks

[3] Based on a paper for the 36th IASP World Conference, Nantes 24 - 27 September 2019.

can make to keep up with the changing requirements by (resident) companies and institutions.

Figure 11: Cumulus Park, Amsterdam (The Netherlands). This innovation district is being developed across various interconnected buildings (a project by Karres en Brands)

Innovation districts as a competitor

Innovation districts have been gaining a lot of attention in recent years. In the first chapter, we defined an innovation district as follows: "A designated zone with its own specific management team, whose main objectives include economic development through the promotion and attraction of selective innovative business for which specific services are provided, and that may also include residential and cultural areas or facilities, or are embedded in urban spaces with such facilities, and with which the economic aspects of the area of innovation interact."

Until recently, innovation districts seemed to be a phenomenon that was strongly represented in the United States of America. Although no research has been carried out into this, it could be assumed that the doughnut structure that had arisen in many cities in the USA and the revaluation of the old central districts contributed to the emergence of these districts. Cheap buildings and land were available for new developments thanks to the decades-long neglect of these old areas. The spatial-economic changes in Europe and perhaps elsewhere in the world have, to a lesser extent, turned away from those central parts of cities. That does not alter the fact that outside the USA something of a catch-up effort seems to be coming: in many cities – and mainly in its central parts – plans for innovation districts are developed, or areas are under construction. Recent research in

Western Europe alone identified at least 70 innovation districts, with some being quite mature and others only just emerging, according to Julie Wagner c.s. (2019).

Characteristics of innovation districts

One of the characteristics of innovation districts often is its centrality to active urban environments. As economies become more specialised and knowledge-intensive, companies increasingly appreciate the way city centres achieve a high degree of face-to-face contact and informal meetings. The prediction that due to new communication technologies “distance is dead”, has not come true.

An ‘open’ structure also characterises the innovation district. There are no sharp borders, and if boundaries are defined, it is just for reasons of coordination. The Knowledge Quarter in London, for example, describes its territory as an area within a one-mile radius of King’s Cross railway station.

Moreover, these central locations give access to a broad pool of skilled and creative employees, whom themselves appreciate the liveliness of inner cities, especially when it comes to shopping and leisure offers, cultural facilities and places to meet with others. Centrally located innovation districts can be reached easily by different modes of transport. However, it is not necessary to travel or commute, as the district and its immediate surroundings offer a great variety of housing opportunities. This mix of functions makes the district dynamic and attractive for young knowledge workers. They seek a vibrant, small community with a combination of living, working and recreation.

From an innovation point of view networks, the offer of services, availability of space, information – among others – are important and make it necessary to have an organisation that takes care of the creation of such a specific work environment and business climate. In the case of an innovation district, this will be an organisation of companies and institutions established in the area, maybe with (some) involvement of the municipality or other relevant parties (Chamber of Commerce, for example). The focus will be on network and community management. Real estate (property) management is not an issue. In an innovation district management, in general, is much more about coordination than it is about control.

Finally, the innovation district might have a mix of target groups. There are no statistics available that can prove this, but looking at the plans for innovation districts, one gets the impression that creating a strong focus has no high priority. Research revealed that innovation districts in the United Kingdom “are seeking to build strengths and develop linkages across a range of different sectors, recognising the benefits of interaction between them. They have all succeeded in amplifying cross-sectoral activity’’ (see chapter 5). In this study it is demonstrated that management organisations coordinate linkages between different industrial,

educational and research activities. “In London’s Knowledge Quarter, examples of cross-thematic collaborations include:

- A strategic partnership between the Public Collaboration Lab at Central Saint Martins and Camden Council. The lab explores the potential for, and value of, a strategic collaboration between design education and local government and how design research and teaching can contribute to service, policy and social innovation in the local government context.
- Through the Digital Music Lab project, City, University of London’s Machine Learning Group is working with UCL and the British Library, alongside Queen Mary University, to develop research methods and software infrastructure to explore and analyse large-scale music collections.
- London Metropolitan Archives worked with the London School of Hygiene and Tropical Medicine on an activity with school children about the spread of infectious diseases” (Arup / UK Innovation Districts Group, 2018).

There is no admission policy in an innovation district. People and companies can establish themselves relatively freely (within the limits of the law). This is of course due to the mix of ownership structures in such a district. On the other hand, science parks often focus on a specific group (or groups) of companies and institutions. The IASP 2018 survey shows that 61% of the science parks and other areas of innovation describe themselves as specialist or semi-specialist.

Using these characteristics as a starting point, we now can present a table that shows differences between innovation districts and science parks (table 4). However, we immediately have to add that this does no right to the many discrepancies one will find in practice!

Changes in locational requirements by personnel

As the demographics of the workforce continuously change, work conditions, workplace and work environment have to change as well. Companies and senior management teams that are most aligned with the new generations of workers in terms of purpose, culture and professional development are likely to attract and retain the best millennial talent (Deloitte, 2018). At the same time, companies have to take care of employee experience, including fitness and wellness programs, balancing financial and non-financial benefits and so on (http://tiny.cc/m6gibz).

Many studies show the shifting interests of young employees. According to a study in the USA, generation Y wants a workplace that offers – among others – flexibility and fun. They ask for modern and edgy workplaces that also stimulate communication and collaboration (Steelcase, 2011). Changes affect not only the inside of buildings but also the outside, including geographical location. Some twenty interviews with entrepreneurs established in Science Park Amsterdam showed that they estimate that the quality of the working environment on the functioning of their employees is determined for 70% by the workplace and layout

of the building. Besides, 12% will be determined by the physical environment and 18% by the facilities in the immediate vicinity. So, the immediate environment has a share of 30%, and this outcome suggests that the immediate surroundings of a building do matter.

Table 4: differences between science parks and innovation districts (simplified)

Characteristic	Innovation district	Science park
Geography	Central	Away from central areas of economic activity, often at the edge of a city
Reachability	Multi-modal	Car-oriented
Functions	Mix, including living	Mono-functional
Services	Great variety	Limited
Cultural events and facilities (employee-related)	Wide range	No events or incidental
Business-related events	Regularly	Regularly
Atmosphere	Dynamic	Neutral
Urban design	No master plan (Existing) urban environment with the addition of new buildings	Master plan New buildings and landscaping
Area	No specific borders	Bounded area
Ownership	Complex: many owners	One owner or a limited number
Management focus	Focus on economic networks and the community Coordination	Focus on economic networks and real estate Control
Target groups	Mix	Often a limited number
Characteristics of companies	Small or medium-scale, easy to mix with other functions	Small, medium and large scale companies. Limited environmental risks accepted.

Young employees seem particularly interested in a dynamic environment. “The work environment, so far largely contained in the corporate building, has begun to spread. Today, the city is the office. Work enters public space, third places and homes, challenging the boundaries between private and public lives, work and free time, and leading to new questions about different cultures, practices, aspirations, and more” (Gall and De Benoist cited in Leyk c.s., 2010). But also, a natural environment can play a role (figure 12). Outdoor space, in particular nature, can have a positive effect on the well-being and work satisfaction of the employees and reduce sick leave (Kaplan, 2007; Terrapin, 2012; see also Bouwmeester, 2010). Moreover, the quality of the work environment can stimulate productivity. 96% of the employees working in Chiswick Park (London,

UK) state that the “enjoy-work environment enhances my productivity” (http://tiny.cc/zghibz).

Although a stimulating work environment with good facilities is highly appreciated, it has to be recognised that these aspects are seldom decisive when it is about choosing a job. Still, it will help people to be more creative, more productive, enjoy work and make them stay longer in the company. Based on case studies and literature, Pancholi c.s. (2015) state that the new generation of innovation areas are increasingly becoming more people-oriented, diverse, open and collaborative. “Major facilitators for placemaking […] are to have a supportive and accessible management environment; vital and collaborative economic environment; vibrant, open and creative physical environment and a well-networked and eventful people environment.”

Figure 12: the importance of a green environment
(Feringa building, Groningen, The Netherlands; a project by Karres en Brands)

Changes in locational requirements by companies

Companies not only consider the requirements of their personnel. The ones that have a strong focus on innovation, in particular, are continuously looking for the right networks to operate in and to be established in. Over the last century, many researchers have suggested, or concluded, that firms tend to cluster because information and ideas move badly over space geographically. Although it was believed for some decades, technology has not caused the ‘death of distance’.

Entrepreneurs are working both globally and locally. Hence, proximity still plays a role, especially in the cases of knowledge and innovation.

Apart from specific qualities of the region, entrepreneurs working in Dutch science parks and having an above-average interest in knowledge/innovation, stress locational factors such as the closeness of a university and the presence of networks between companies and institutions (see chapter 3). Based on a limited number of interviews with entrepreneurs settled in Canadian science parks Castonguay c.s. (2018) determined the following factors (without ranking): linkages/sharing knowledge between companies (agglomeration effect), the availability of premises and equipment, the availability of skilled human resources, financial incentives, the reputation of the park, the geographical proximity with specific actors and the geographical positioning of the park. Answers by managers of science parks around the globe also point at the importance of proximity to other companies and institutions. 59% have the opinion that the quality of resident companies is an essential factor for the competitiveness of science parks and areas of innovation (IASP, 2018).

The above shows the current requirements. We haven't been able to detect research, based on surveys focussed on entrepreneurs, that gives a clear picture of future needs and that can help to design strategies for the (re)development of science parks. Nevertheless, it is clear from the changing requirements by personnel that this will influence the locational choices of innovative companies, as attracting and retaining talent is crucial. Although 'talent' is a regional characteristic, the possibilities of attracting talent will also depend upon the location chosen in that region. Among others, multifunctionality, dynamism, and an environment that stimulates encounters and creativity seem to be important.

Moreover, from a sustainability point of view, companies might be interested in locations that have multi-modal accessibility. It is our impression that during the last two decades sites that have no multi-modal access were less appreciated by management. This might have contributed to a revaluation of the qualities of central areas by a part of the business and can be of relevance concerning future location choices by entrepreneurs.

Another trend that is worth exploring is a growing interest by companies in crossovers, as mentioned before (chapter 2). In the recent past companies seem to cluster with other companies in the same or adjacent sectors. Pancholi c.s. (2015) suggest that newly emerging knowledge and innovative areas seek diversity in terms of industries, firms and also in terms of knowledge workers for their long-term viability and knowledge exchange. A study by Gwebu c.s. (2019) concludes that firms residing in science parks with more co-located complementary firms demonstrate better sales and sales growth performance. These research outcomes are consistent with a trend in which crossovers between industries are emphasized, assuming that this leads to innovations and

better business results. A paper by Sharp c.s. (2011) argues why the convergence of life sciences, physical sciences and engineering is of great importance, especially with regard to the future of health care. They see convergence as a blueprint for innovation and state that such a convergence will provide a new knowledge base.

Figure 13: the innovation district 22@Barcelona offers start-ups and established businesses a creative space in a dense urban environment

Another trend is a (possible) response to the trend of de-concentration. In Europe in the sixties of the 20th century, apart from some centuries-old universities (Cambridge for example), many universities tended to concentrate their activities in areas at the edge of the city where sufficient space was available. The upcoming phenomena of science parks at that time and the link these parks sought with the university also led to favouring isolated areas at the edge of the city. For both developments, science parks and universities, there is growing criticism about this spatial pattern and the way it functions. Too mono-functional, too much focus on car accessibility, too far away from the inner city, not well connected with or embedded in the city, and so on. Some science parks try to find solutions for the problem (if it is perceived as a problem) by developing living quarters on the park, which also helps to ease the threshold for facilities and services in the park itself.

Companies also seem more interested in ‘density’. It seems that the developments, as mentioned above, have stimulated the rise of innovation districts. The changing functions of inner cities and the mass re-allocation of traditional industries from the inner cities and surrounding old quarters give room

for new developments such as innovation districts. Innovation economies reward urban density because of agglomeration effects. Open innovation stresses the importance of working nearby, being able to share ideas rather than invent in isolation.

In line with the above, it is also notable that companies are revaluing vibrancy and authenticity in (inner) cities. This trend is an extension of the former one. It is well-known that artists, people working in creative industries and researchers value a sense of place, including coffee shops, art galleries, and so on. A work environment that encourages creativity and innovation, and offers a balance between life, work and play. Such an environment is more important for millennials, which is an important target group for innovative companies and research universities in their competition to get the best talent.

Considerations

Looking at today's science parks in general, there can be a conflict between the expectations of managers and employees on one side and the qualities of an established science park on the other. Changes in demand can put the market position of (older, depreciated) science parks under pressure, whereas innovation districts seem to be successful, although hard evidence seems to lack so far. Looking at table 4, we might find inspiration here to modify the science park concept by transferring some of the assumed success factors of innovation districts to that concept. We like to suggest three considerations that might help the management of science parks to adjust to the present and near-future demand by the people working in these innovative companies and the companies themselves:

- consider adding housing (including an impact on service level and reachability);
- consider a shift towards multiple target groups;
- consider laying more emphasis on community management.

Especially with regard to the first two considerations, one has to keep in mind (again) that a science park is not a closed entity in a region. It is part of that region: an ecosystem within an ecosystem. Setting out new strategic lines for a science park also asks for a re-orientation of the position and role of the science park in the region.

Consideration 1: adding housing

Innovation districts offer a variety of housing options. Can that be realized in a science park? An interesting aspect is that building houses and (student) apartments will broaden the economic base for services on the estate. That includes the reachability by public transport. It is also often suggested that adding housing should bring more liveliness and might help to create a community of knowledge workers, entrepreneurs and students. But the vibrancy (especially in

evening hours) should not be exaggerated: it will often be the same as in every other neighbourhood.

Talking about the opportunities for housing in a science park starts with the question about the amount of space available. Since a science park can only function properly if there is 'mass' (plenty of room for the establishment of companies and institutions that can interact with each other), it is relatively easier to think about housing when a science park is large (in terms of hectares) and – of course – has sufficient space available. Allowing housing on land that can also be used for innovative companies and knowledge institutions requires a sound underpinning of the added value. If that is only on the financial level, that added value is up for discussion. Think off adding housing (sometimes not even aimed at knowledge workers) to get a healthy financial exploitation. This is the case, for example, in the Alderley Life Sciences Park (near Manchester, UK) where "the funds are released from that [residential] development to be used to deliver the desired Life Science Park." A link between who lives there and the science park is not laid in the plans for that science park. Something similar also applies to residential construction in Hong Kong Science Park and Dubai Science Park. Housing plans of the Bio Science Park in Leiden (The Netherlands) have a different approach. One thousand homes will be realised that are intended for students, graduates and employees of knowledge institutions and companies that are located in the park. With this, one hopes to create a residential climate that meets the requirements that are set today. The High Tech Campus in Eindhoven (The Netherlands) wants to house ex-pat families. In 2013, the High Tech Campus researched companies to gauge the need to live in the park. At that time, there was hardly any demand. But in the meantime, opinions have changed, according to a recent survey among the largest companies. Ex-pats who now come to Eindhoven sometimes have trouble finding suitable housing. Then they end up somewhere in a neighbourhood too far away from the campus, at a much too high rent. By offering them temporary housing (2 – 6 months), ex-pats will have more time to orientate themselves and find the right accommodation. Other examples of including housing in the concept can be found in Manchester (UK) and Berlin (Germany). In Adlershof Science Park in Berlin, 1,600 rented houses and apartments are now being built, as well as 400 apartments for students. A hundred homes and apartments are being constructed in Didsbury Science Park in Manchester.

In these latter examples, the development is connected with the science park development. Still, it is not clear whether this is accompanied by a strict admission policy so that only the intended target group will settle in the science park. So, if one chooses to add housing specifically for knowledge workers or students on the estate, management has to keep control over the type of households that are admitted. Such control can be organised by renting the houses and apartments instead of selling them. Such a policy broadens the activities of management, which is not always desired. Higher price levels can also

have a selective effect, but it is still uncertain whether this leads to the preferred group of residents.

Although creating living quarters on a science park might seem an interesting opportunity, one has to keep in mind that not everyone will be interested. A science park might serve a particular market segment, but it is possible that specific target groups are much more interested in another offer elsewhere in the region. The care for a sufficient and sufficiently varied housing supply for knowledge workers is primarily a focal point at the regional level. From numerous discussions with knowledge workers and entrepreneurs, it is clear to us how important the quality of the residential and living environment is. However, there is not one ideal living environment for the knowledge worker. The residential environment sought by knowledge workers partly depends on the stage of life in which the household is. A region must therefore have a housing policy that takes account of the requirements of knowledge workers. Within such a varied regional offer, the science park can take a specific, distinctive position.

Consideration 2: shifting towards multiple target groups
Given the mix of activities in innovation districts, one could conclude that possibilities for cross-fertilisation seem to be valued by knowledge workers, institutions and companies (assuming that short distances do matter). If this mix of industries in innovation districts is a success factor, it might be interesting for specialised science parks to investigate the added value of broadening their target group. Of all parks in the IASP survey of science parks and areas of innovation 25% is specialised and 37% says to be semi-specialised (IASP, 2018). So, 38% of science parks have a broad scope. These figures do not necessarily point at a base for successful crossovers, for it is not clear what the admission policy is.

Given the growing interest in crossovers/convergence, the search for companies that have the same knowledge base might be more rewarding than the choice for specific sectors. We have described the trend already (chapter 2). It is interesting to see that a similar idea can be found in regional economic geography: the concept of ‘related variety’. This idea suggests that regions may benefit from producing a variety of products and services, as more variety implies more potential for inter-industry knowledge spill-overs (Frenken et al., 2007; Content & Frenken, 2016). Knowledge originating from one sector is most relevant to, and can most effectively be absorbed by, another industry that is related in the sense that companies draw on similar knowledge (about technology, markets, etc.).

So, if science park management wants to stimulate diversity and inter-industry relationships one has to keep in mind that this is probably most successful if companies and institutions involved, although having different activities, do have a similar knowledge base. That could be the leading principle for an admission policy. However, also in this case we have to keep in mind the regional setting. Linkages are never limited to the science park itself.

We present the hypothesis that the larger a science park, the better it is to have a broad range of activities, using the same knowledge base, as the size of the park offers many opportunities for interactions and possibilities for cooperation. The smaller a science park, the better – probably – the creation of a specialised cluster that is very well connected with companies and institutions in the innovative region. This is not to say that large science parks shouldn't be connected with the region, but maybe to a somewhat lesser extent.

When thinking of knowledge bases, it is interesting to mention the hypothesis by Van Winden & Carvalho (2016). They suggest that activities that rely on symbolic knowledge (e.g., media, design) tend to have a stronger preference for urban settings. This could be less the case for activities based on analytical and synthetic knowledge (e.g., biotechnology and advanced engineering). This hypothesis can be seen as an invitation to think about a division of tasks between centrally located innovation areas (often innovation districts) and non-central suburban innovation areas (as is the case with many science parks).

Consideration 3: laying more emphasis on community management
Good integrated management is a characteristic of a science park and a huge part of management activity is focussed on networks and resident companies. Think of business development, incubation and acceleration, setting up international relations, investor relations and knowledge transfer. When looking at management activities, we would like to make a distinction in network, property and community management. We argue that more attention should be given by science park management to community management to create a high-quality workspace. The atmosphere, the events, the availability of 'third spaces', the retail services, and so on, make an innovation district distinct and attractive and probably a competitor of science parks.

Apart from the possible competition with innovation districts, we think that community management is relevant because of the type of working environment knowledge workers are seeking today and the impact it can have on the functioning of companies. But first: what are we talking about? The focus here is the community, defined as the entire group of people working in the estate. The question is how to create a workspace that helps the community to be creative and productive, and that creates a healthy and creativity stimulating work environment. Here we can make a distinction in tangible and non-tangible services. Among the tangible services are services that can be found in buildings or have a specific physical infrastructure. Think of sports facilities, pubs, nursery, restaurants, dry cleaning, shops, and so on. Management can at least facilitate these services, but in many cases, they even have full control. With regard to leisure services half of these are owned by the science park. In the case of social services one third is owned by the science park. Half of both these services are run by a third party (IASP, 2018). However, the successful offer of these services is

dependent upon the size of the consumer base. Hence, management has limited power with regard to this kind of offer.

The creation of a pleasant, creative atmosphere (design, landscaping), the organisation of social networks (including meeting, parties and the like) and the offer of events and sports games are clear examples of non-tangible services. In a somewhat broader context, the availability of bikes and courses and fitness and wellness programs could be considered as non-tangible. And although the consumer base plays a role here too, there might be more opportunities here, given the changes in the demographics of the workforce, and hence the requirements by knowledge workers. We do know that if high-quality community management is among the assets, as is the case in Chiswick Park (London; figure 14), it is highly appreciated. 91% of the workers on Chiswick Park say that events add value to their work-life; 63% states that summer sports add value; 95% says that the physical environment and 67% says that health & wellness activities add value to their work-life (http://tiny.cc/arhibz).

Figure 14: Chiswick Park in London is perhaps the good, most extreme example of varied community management

Tangible and non-tangible services can have a positive impact on the people working in a science park. Still, they can also stimulate informal meetings, exchange of information and the creation of networks, all of which are essential inputs for the functioning of a science park. In the case of High Tech Campus (Eindhoven, The Netherlands) landscaping is supposed to stimulate this: lots of

green, hiking trails and many benches near the central lake and along the paths. Concentrated parking facilities and services (The Strip) makes it necessary to make short walks and stimulates meeting other people. The same design concept can be found in other science parks, for example Green Park (Reading, England). But there is more at the High Tech Campus: companies are not allowed to have their own company canteen. In-company meeting rooms are permitted to a maximum of 25 people. For food and larger meeting rooms, people should move to The Strip where all services are concentrated.

Open for discussion

During the past sixty years science parks have been very successful and were able to adapt to new demands and requirements over time. Science parks have changed from a real estate concept towards an important innovation and network concept that contributes to the success of companies and regions. Science parks now have management organisations that are aimed at removing concerns about daily, irrelevant matters among their resident companies and institutions and connecting these with other companies and institutions in and outside the park.

In the Fourth Industrial Revolution science parks probably no longer will be the most prominent concept. Demand by companies and knowledge workers is changing and new concepts, like innovation districts, are coming up. This does not mean that science parks are at the end of the life cycle. Especially the older ones need new investments and programs to keep up with the changes. Taking the assumed success factors of innovation districts as a starting point, we have presented in this chapter three considerations that might help (older) science parks to become more competitive. These are early ideas to open up the discussion about new requirements for science parks in the coming decades.

Looking for research outcomes during the writing of this chapter it became clear that much is argued by authors and scholars, but less is researched well. There is a severe risk of taking arguments from conventional wisdom and not robust analysis. A research agenda for the coming years could be based on:

- the future locational demands by the managers of knowledge-intensive (innovation-oriented) companies and institutions;
- the importance of the elements of a creativity stimulating work environment for knowledge workers;
- the possibility of a division of tasks between different types of innovation areas and the way such a variety can stimulate regional development.

5. The emergence of innovation districts in the UK [4]

In the 1980s and 1990s, ideas about the West European economy changed from service economy or post-industrial society into knowledge-based economies. Innovation was considered crucial to be able to compete worldwide and, by doing so, to prosper economically. From that moment on the generation of knowledge, the establishment and growth of networks of business and knowledge institutions and the availability of high-quality education (and in the end a high-quality workforce) were considered to be essential to hold or strengthen economic positions. Information and communication technology play an essential role in the networks needed: the exchange of data, information and knowledge. But this technology seemed to make distances disappear. That is why three decades ago the concept of 'death of distance' was introduced. It questioned the necessary proximity of persons in the case of knowledge exchange. The concept did not hold. Areas of innovation, such as science and technology parks, still had a reason for existence. However, it was realised that, as the economy became more knowledge-based, it was both spatial proximity and high densities of face-to-face contact as well as being well incorporated in global networks that make the exchange of information and ideas, and hence innovation, successful. Knowledge-driven firms value being in locations where they have wide access to a skilled workforce, and which can provide the spaces and networks for people, firms, researchers, clinicians, entrepreneurs, creatives and investors to collaborate, compare and compete.

Thanks to agglomeration effects it is the cities and urban agglomerations that have the best opportunities for companies and institutions to innovate. Within these urban agglomerations the areas of innovation, where innovative firms, universities and other institutions cluster, still play a role. In recent years the typology is even broadened. Initially, areas of innovation consisted of science and technology parks and industrial co-innovation parks, but in the 1990s a cautious, new development was detectable. There was a steady growth of start-ups, and for most of them, science parks were too expensive or (still) had too much a focus on real estate instead of managing and stimulating the local networks. Former manufacturing districts and city centre fringe seemed to be more attractive for this group of entrepreneurs thanks to the low rents. The real estate market saw new opportunities and started to create 'creative factories' in old buildings. Restaurants, copy shops and other service activities detected the new opportunities and new, unplanned developments occurred. Examples in London are Old Street Roundabout (also known as Silicon Roundabout) and Shoreditch.

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[4] Based on a paper for the 36th IASP World Conference, Nantes 24 - 27 September 2019. Written in close cooperation with Tom Bridges BSc, MSc, MRTPI, Leeds Office Leader, Director Cities Advisory, Arup.

These kinds of developments made local governments curious and made them think of helping to create such districts – now known as innovation districts – to stimulate the economy and, at the same time, rehabilitate old (industrial) areas in their cities.
Poblenau Quarter in Barcelona used to be a vital, large industrial district and is generally considered to be the first government-led development of an innovation district in Europe. Almost at the same time, comparable developments started in the United States. Members of the International Association of Science Parks (IASP) noticed the trend, and it eventually led to changing the name into the International Association of Science Parks and Areas of Innovation (still abbreviated as IASP). But for somewhat unclear reasons a publication by the Brookings Institution ensured that the concept of innovation districts came to the centre of attention in 2014.

Many innovation districts in the United States have since then been standing in the spotlights, but the UK story (with London as an exception) is less well-known, despite the success achieved by the first wave of innovation districts and the considerable potential of others. As a result, there is a risk that the UK will not grasp this opportunity fully. We need to ensure that innovation districts secure the investment and support necessary to maximise their success. Arup has worked with the UK Innovation Districts Group to assess the progress made by innovation districts, factors for success, issues to be overcome and the priorities and opportunities for the future. The research has included a review of literature and interviews with those involved in innovation district projects. This chapter describes some intriguing developments in the UK. Based on these and other developments (which can be found in the full report; Arup, 2018) a series of recommendations to make the most of the opportunities innovation districts offer is set out.

The six innovation districts that were the focus for the research

Manchester: Oxford Road Corridor
Co-located on the Corridor are two universities, five specialist hospitals, local government, entrepreneurs, global businesses, cultural assets and an Enterprise Zone. The Innovation District is underpinned by world-class research and has particular specialisms in advanced materials and health and life sciences. An ongoing series of transformational investments have created an environment that has seen exceptional jobs and GVA growth. This pro-active approach to place-shaping has supported the development of a broader mix of uses and has seen improved public realm and shared spaces; the introduction of ‘Dutch cycle lanes’ and traffic restrictions; development of new cultural facilities; and the integration of leading-edge smart city technologies. Targeted business interventions have focused on accelerating innovation, commercialisation and improved health pathways.

Glasgow West End and Waterfront Innovation District

This area is an ideal environment for innovation. It boasts one of the world's largest hospitals, a top 100 research-intensive university as well as cultural facilities on the banks of the River Clyde. With the main partners – Glasgow City Council and Scottish Enterprise - and the support of the Scottish and UK Governments and the wider business community, Glasgow University is establishing an innovation district that will help push Glasgow into the top rank of global innovative cities. Within the innovation district, Kelvingrove Art Gallery & Museum and the Riverside Museum combined rank 10th in all UK visitor attractions. Glasgow also boasts one of the most successful music venues in the world – the SSE Hydro. The West End and Waterfront area also host the BBC, STV and other media companies, together with the University and its own significant art and museum collections. The redevelopment of the city's historic Kelvin Hall, believed to be the first place in the world to combine major collections with health and wellbeing linked to sport under one roof.

Leeds: Innovation District

The Innovation District will be focused on the academic and economic strengths of the city, particularly health innovation, engineering, financial and business services, data analytics and digital technologies. Digital pathology innovation is the core of the development as Leeds is a globally leading centre in this field. The development boasts the largest online pathology repository in the world. The collaboration between Leeds Teaching Hospitals Trust and the University of Leeds has created several novel spin-out technologies and applications. For example, their strategic partnership with Leica Biosystems has led to full digitisation of their pathology lab and establishment as the Leica Global Centre of Excellence in Digital Pathology. Digital Pathology provides significant opportunities to apply artificial intelligence and machine learning to increase the speed and consistency of cancer diagnosis.

Liverpool: Knowledge Quarter

In the heart of Liverpool's Knowledge Quarter are two University campuses, the School of Tropical Medicine and the Royal University Teaching Hospital, as well as Sensor City and the Materials Innovation Factory. Interesting to see that also the Liverpool Science Park is established here (two buildings). Eye-catcher, among others, is the Centre of Excellence in Infectious Disease Research (CEIDR), launched in 2017 by the University of Liverpool and the Liverpool School of Tropical Medicine and focuses on translational partnering in infectious diseases. CEIDR provides a single point of access for the industry into a broad infectious disease expertise base in Liverpool for translational activity and helps to develop relationships with industries. Apart from innovative firms and institutions and learning Knowledge Quarter offers a mix of cultural activities, theatres, cafés, restaurants and the likes.

London: Queen Elizabeth Olympic Park

In this area, where the Olympic Games have been held, a new Culture and Education District will be developed, focussing on education, innovation and enterprise. Already two universities are established here (including the Advanced Propulsion Centre and the High-Speed Sustainable Manufacturing Institute) and three more will be located here soon. Based in the former Olympic Press and Broadcast Centre, Here East provides space for start-ups and companies, offering a high-quality work environment. Special attention is given to programmes that support these entrepreneurs and help to build linkages between companies and universities. For Queen Elizabeth Olympic Park, the Knowledge Quarter at King's Cross is an inspiring example. It is even suggested to create a link between the two developments, as they are only seven minutes away by high-speed rail link.

Figure 15: Knowledge Quarter, London

London: Knowledge Quarter

Within a one-mile radius of King's Cross (approximately a 10-12 minute walk) is a remarkable cluster of organisations spanning research, higher education, science, art, culture and media. Individually, they offer resources for specialists in numerous fields, from architecture and the arts to biotechnology and veterinary science. The Knowledge Quarter brings together over 85 cultural, research, scientific, business and academic institutions both large and small under one umbrella. The Knowledge Quarter fosters knowledge exchange and collaboration between staff and users of cross-disciplinary communities to exchange ideas, expertise and evidence. Developing networks to encourage collaborative projects, training, commissioned research and access to funding, engaging a wide variety of audiences and benefiting the local research community.

Main features and typologies of UK innovation districts

The research identified the main features of UK Innovation Districts. There are three main categories of actors. First, there are knowledge-producing anchor institutions such as research universities, major teaching hospitals, and other research bodies. In some UK innovation districts, this includes cultural institutions. Professional bodies such as the Royal College of Physicians (in KQ London and Liverpool) are also important. Many of these organisations are investing significantly in new buildings and campus developments, and in doing so, seeking to reflect the increasing importance of supporting local economic growth as part of their mission.

Second, there are knowledge-intensive firms that value proximity to the knowledge-intensive anchor institutions as well as each other. These firms range from start-ups and spin-outs from universities and other publicly funded organisations, fast-growing technology-driven scale-up firms, to larger corporates who locate part of their research and development and intrapreneurship functions in innovation districts. A proactive and coordinated approach to build appropriate networks and relational infrastructure between the different actors is essential for a thriving innovation district. The engagement of angel investors and venture capital is also a necessary feature for success.

Third, innovation districts require the development of the right type of physical spaces: workspaces; collaboration space; infrastructure; and public spaces. A range of workspace is needed to accommodate and facilitate the growth of knowledge-intensive firms of different types. This may include specialist physical requirements for lab space. Formal and informal spaces are required in order to foster collaboration and interaction between organisations and their people, including co-working space, areas for met-ups and conferences, as well as cafes, bars and restaurants. Increasingly, high-quality public realm, good physical and digital connectivity and a strong amenity offer and vibrancy is needed to support informal interaction and networks, as well as creating an environment that is attractive to knowledge workers and occupiers. The management, programming and curation of activity in these spaces are essential, in addition to the physical design.

Government is also an important stakeholder. At a national level UK Government directs research spend in the context of its National Industrial Strategy, and there is scope to focus and join-up this investment more effectively within places, including Innovation Districts. National and local government also have research-intensive departments or agencies that contribute to the success of innovation districts. Example include NHS Digital in Leeds, the Financial Conduct Authority or Transport for London at Queen Elizabeth Olympic Park in London. City Government also has a significant role in the planning, promotion, leadership, governance and public sector investments necessary to make innovation districts a success.

It is possible to identify a physical typology of UK Innovation Districts, as set out in table 5. Increasingly knowledge-intensive jobs are clustering in the CBDs of UK cities. Several cities such as Manchester, Leeds, Bristol and Newcastle are expanding the physical size and economic contribution of their city centres through regenerating and connective city centre fringe innovation districts.

Table 5: a locational typology of UK Innovation Districts

Type of Innovation District	*Examples*
City centre expansion – the development of new urban quarters, or strengthened connections with edge of city centre campuses, to expand the size and economic contribution of city centre economies and central business districts.	Oxford Road Corridor, Manchester Leeds Innovation District Knowledge Quarter London (in so far as the Kings Cross Central scheme has expanded a long-established knowledge quarter) The emerging Bristol Temple Quarter district next to Bristol Temple Meads Station Newcastle Science Central
New urban quarters – generally in inner urban areas based around major transport nodes, expanding campuses, and improved connections to city centres and surrounding developments and neighborhoods.	Queen Elizabeth Olympic Park, London Glasgow West End and Waterfront Innovation District Knowledge Quarter Gateway and the Paddington Village development within Knowledge Quarter Liverpool
Out of town technology parks – whilst not the subject of this report, some out of town technology parks are being repurposed and reinvented as innovation districts, with a wider mix of uses, and stronger links to nearby city-based innovation assets	Advanced Manufacturing Park, Sheffield Alderley Park, Cheshire Proposed University of Leeds Technology Park in Aire Valley Leeds National Manufacturing Institute for Scotland at Inchinnan, Renfrewshire

Others are creating or enhancing separate new urban quarters that are well connected with the CBD and other economic assets. The most high-profile example is the Queen Elizabeth Olympic Park in East London which has benefited in huge transport infrastructure investment to connect it to central London and Canary Wharf, as well as to surrounding centres and neighbourhoods. Other examples include the Glasgow West End and Waterfront Innovation District where recent and current investments in a major expansion of the university campus, a new hospital, and new conference and exhibition facilities are being brought together to create a coherent urban district. In Knowledge Quarter Liverpool, new campus and commercial development is creating a vibrant urban district.

Progress and lessons

This chapter looks at the progress and lessons from the six innovation districts that form the UK Innovation Districts Group. These projects are at different stages of development. All innovation districts seek to build strengths and develop linkages across a range of different sectors, recognising the benefits of interaction between them. They have all succeeded in amplifying cross-sectoral activity. This is based on an understanding of particular areas of expertise, informed by evidence (including Science and Innovation Audits). This approach combines a broad-based approach along with a focus on specific strengths, seeking to increase agglomeration and knowledge spillovers. There are also similarities and potential linkages between innovation districts and the potential to build on collaborations between academic institutions.

There are differences between innovation districts in the way in which they seek to support entrepreneurship. Providing incubation and collaboration space and support is an important focus of most (but not all) of the projects. There are differences in the extent to and the way in which these spaces are curated by research-intensive organisations. In some cases, the approach to supporting business start-ups and scale-ups is integrated within wider approaches to business support in relevant cities and city-regions. However, in other cases, there is not a structured approach to attracting and growing firms within the innovation district. There is a view amongst some of the stakeholders interviewed for this project that more could be done to build the wider ecosystems of support for commercial spin-outs, start-ups and scale-ups.

Cultural institutions and attractions are becoming an increasingly important component of innovation districts. Several innovation districts include, or are close to, significant cultural or visitor attractions, and they are securing new investment from cultural bodies which want to move into these areas or upgrade their existing facilities. Several also include arts and cultural academic institutions and departments. This adds to the offer of innovation districts. It provides an important area of academic research for some, one of which is relevant to the economic trend of increasing synergies between technology and the arts. Cultural institutions also create a buzz, vibrancy and activities in evenings and at weekends, helping to retain the student population post-graduation.

Innovation districts are supporting inclusive growth. Some innovation districts are involving partners and organisations in initiatives to forge links with schools and young people in the surrounding areas. This increases awareness of, and access to, the range of learning and career opportunities available to them, providing mentoring, advice and work experience. Innovation districts are creating new public spaces and amenities for residents of nearby areas, and through physical investments are linking these residential areas to education and employment opportunities.

Successful innovation districts require substantial capital investment in infrastructure and place-shaping. A feature of well-established, successful innovation districts has been large-scale capital investment in the public realm and infrastructure. More investments are asked for by digital infrastructure. This is an important ingredient for success. Several innovation districts are developing strategies for investment in advanced digital infrastructure, including fibre to the premises, 5G, and sensors and Internet of Things systems, and are putting in place frameworks for exploiting the research and economic potential of the data that will be generated from this. They are becoming exemplars in the context of the smart cities agenda and are creating new platforms for testing and developing advanced urban services. And talking about investments, it is obvious that a proactive and enlightened approach to development is required to build the right type of business space to attract and accommodate the right type of occupiers. More attention is paid to the way the design of buildings can help to create linkages and an image of openness. Whereas previously buildings and spaces between them faced inwards, increasingly the design of new buildings and campuses are facing outwards. The aims are to attract people into these buildings and spaces, encourage and facilitate interaction between people and animation, and improve connectivity with other assets and areas.

As said before, the concept of an innovation district initially was a spontaneous one, without any governmental meddling. Given the potential of such developments, that seem very well to fit new demands by companies and institutions, leadership and coordination are essential to successful innovation districts. A feature of all the projects considered for this research is that they are being championed and steered by the relevant university Vice-Chancellors, NHS teaching hospital trust chairs and Chief Executives, and local authority/development corporation Leaders and Chief Executives. The successful projects have been prioritised for investment at a city or city-region level.

Good leadership and coordination need a clear vision and plan, which can flex over time. Many of those interviewed stressed the importance of setting a clear vision and masterplan and embedding this in planning policy to provide a clear and consistent framework for development. Whilst it is important that this can flex over time, several interviewees identified the risk of allowing or bringing forward development that offers a short-term commercial gain, which may not be in the long-term best interest of the core mission of innovation districts.

Several of those involved in the interviews and discussions through this research spoke about the importance of linkages between innovation districts and wider networks as economic assets in their cities and city-regions. The general view is that innovation districts can provide a useful focus for promoting innovation across the economy of a wider city or city region area.

Figure 16: Glasgow West End and Waterfront Innovation District

Conclusion and recommendations

Government should prioritise support for economic growth in the places and initiatives where it has the greatest chance of a return on its investment. Innovation districts are enabling our cities to create new products, processes, technologies, and high growth firms that will drive productivity growth. They are supporting the creation of new, high-quality jobs in accessible locations, regenerating parts of our cities, and supporting inclusive growth. A clear conclusion from the research is the importance of developing the right softer networks and relational infrastructure between actors in innovation districts alongside the approach to developing the right buildings and physical infrastructure.

The main conclusion from this research is that government should prioritise place-based investment in innovation districts to boost productivity, support inclusive growth, and to deliver the Industrial Strategy.

Innovation districts and knowledge quarters are emerging as transformational projects which are driving economic growth. Knowledge-intensive jobs and firms are increasingly clustering in or near city centres where innovators, entrepreneurs and R&D intensive businesses can benefit from access to a vast pool of skilled people, university researchers, healthcare clinicians, and knowledge spillovers. This is a result of people and organisations collaborating, comparing and competing across different sectors. Cities, universities, teaching hospitals, cultural and professional institutions are supporting and capitalising on this trend through

significant investments in new buildings, campuses, workspace, and public realm which are creating new urban districts and engines of more productive growth. These projects are at different stages of development in different locations, and there is a range of approaches and areas of focus. Generally, the focus on innovation has emerged in response to a physical regeneration opportunity and reflecting how new infrastructure and place-shaping has attracted innovative organisations into areas.

Universities, hospitals and cultural institutions are recognising their role as anchor institutions for economic growth. Cities are recognising the need to support initiatives to boost productivity and to attract and grow the firms that will create new products and processes to create and sustain, wealth in the future. And enlightened developers are recognising the opportunity to support new patterns of working, living and leisure in urban areas.

The full potential of innovation districts will only be realised if there is stronger support from different tiers of government, and if all cities and innovation district projects ensure there is a clear focus and sufficient resources (both in developing and delivering these projects), and by working more closely together. Through a renewed focus on support for innovation districts, the UK and devolved governments and cities can help deliver against the aims of the Industrial Strategy, secure accelerated productivity, support inclusive growth, continue to reshape and regenerate our city centres, and build the networks of collaboration to create the firms, products and processes to drive forward our city economies.

We would like to end with the following recommendations (details can be found in the report; see the reference at the back of the book):

- government and cities and city-regions should prioritise innovation districts to support the delivery of the Industrial Strategy;
- innovation districts should build on their existing work to help lead the way in increasing productivity through inclusive growth;
- innovation districts should work together more closely as a national network;
- cities, city regions and innovation districts should continue to secure capital investment in public spaces, physical and digital infrastructure, and new buildings in innovation districts;
- government, LEPs and Combined Authorities, and cities should invest in developing the hard and soft networks to support business growth in innovation districts.

IADP in the picture

IADP excursion to Barcelona, 2018

IASP World Conference, 2019

IADP Winter Seminar, 2019

IASP World Conference, 2017

IASP European Conference, 2017

IADP Autumn Seminar, 2019

6. The university as a catalyst in innovation district development [5]

Until the 1990s, there has been a strong focus on the physical aspects, mostly real estate, when developing innovative working environments. This focus was typical for the first decades of the, quite often mono-functional, science park concept. Nowadays, we very clearly understand that developing a science park or another type of innovation area is not (solely) a real estate operation. We – and others – like to stress the importance of the functional linkages between companies, institutions and universities enforced by strong management of these networks. The added value of an innovation area is in these networks, but also in the creation of a work environment that stimulates creativity. Altogether also known as the 'software'.

Drivers

So, in today's innovation areas, the development of a knowledge network of companies and institutions is essential. The same goes for the creation of a community (which is more focused on personnel, organising activities and an excellent workspace). Altogether this forms the ecosystem. Although this doesn't alter the fact that ultimately businesses and institutions located in the innovation areas also need modern real estate, adaptive infrastructure and attractive public spaces. Given this, specific requirements can be placed on buildings, particularly respecting the needs for community building and networking. For instance, pedestrian flows, the creation of meeting points, the concentration of catering and restaurant facilities where pedestrian flows meet, creative work environments, and so on. For the successful management of any area of innovation, it is crucial that the different layers in the social-spatial structure of a site or area are recognised and respected: the networks, the infrastructure and the buildings.

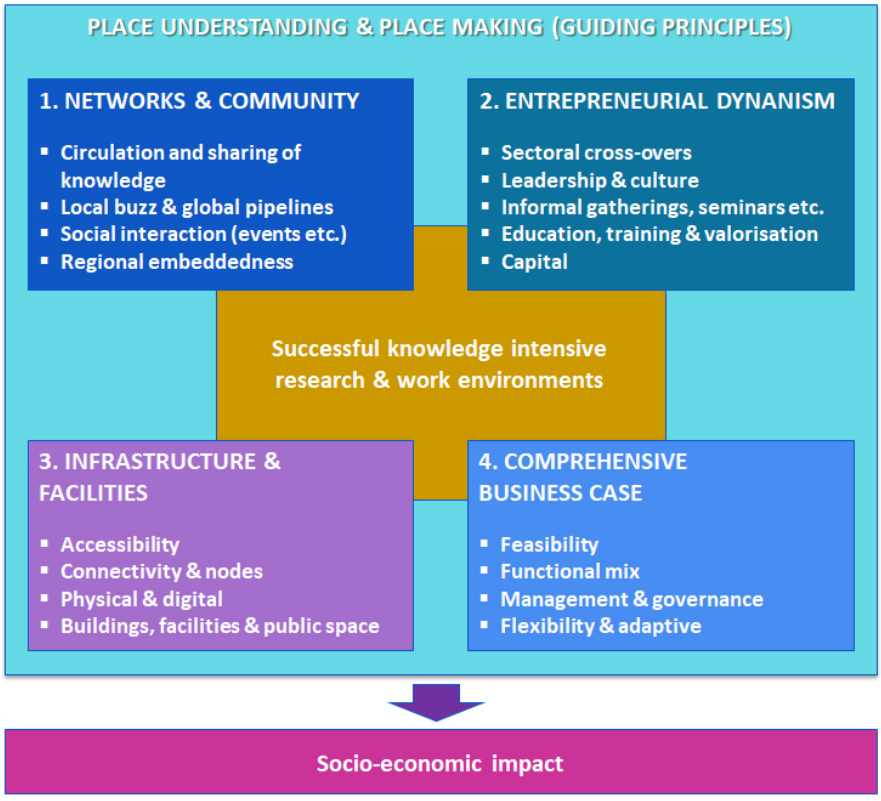
But first of all, the 'guests' in the estate (companies, institutions, others) are central. In many cases it can be observed that one guest is 'leading' or – better said – is considered to be the 'anchor' of the development. That is often a university in the case of a science park and – per definition – a large, innovative company in the case of an industrial co-innovation park. But what about the upcoming innovation districts? The available literature points out that in general one has the opinion that a thriving innovation district needs at least one anchor firm or institution. This can be a research university, another institution working in the field of research and innovation or a (large) company.

[5] Based on a paper for the 35th IASP World Conference, Teheran 2 - 5 September 2018.

Altogether we like to distinguish four crucial drivers when looking at and analysing all types of areas of innovation:

- networks & community;
- entrepreneurial dynamism;
- infrastructure & facilities and
- a comprehensive business case (figure 17).

Figure 17: IADP-model to create successful R&D work environments (https://iadp.co/about/)



The leading question for this chapter

Given the great importance of innovation and the exchange of information between stakeholders involved, (research) universities and leading, innovative firms probably plays a crucial role in the development of innovation districts. “Probably” because, as far as we know, there are not yet research outcomes available that make clear what precisely that impact can be. Until now, it is more about expectations.

In this chapter, we mainly focus on the role of universities in innovation districts. These districts are characterised by their embeddedness in the city, innovation, a dynamic mix of functions and good public transport. It seems that for a growing number of firms and institutions, active in the fields of science and innovation, the innovation district is the working environment of the future. Such an environment might also (or maybe specifically) attract the millennials in the war for talent. Given the link of science parks with universities, this raises the question if an innovation district can be booming without a university in the district? Or, in case of an already established university or university institution: can such a university be the starting point for an innovation district?
The latter question is posed by the University of Amsterdam, The Netherlands. This university is very well established in the city with three of their four sites located in Amsterdam. An 'interconnected concentration' of specialised clusters, which together constitute a network of knowledge and individually function as catalysts for their immediate surroundings. One of these clusters is situated in the inner city, and the university intends to create an innovation quarter ('University Quarter') here, consisting of university buildings and the surrounding area. It is the opinion of this university that a modern university is no longer an 'ivory tower'. It stands in the middle of society and in front of that society and is a crucial member of a modern, knowledge-oriented society. Against this background, the question arises how the University Quarter can be turned into a success. The aim is to create added value to the university, the environment and the city and what role the University Quarter plays in this respect. Also, the surrounding area is vital to the university: the space between the different buildings, but also between the clusters, needs to stimulate the interaction between inhabitants, students, companies and knowledge institutions. At the sub local level (University Quarter), that space must also provide a pleasant working environment that stimulates creativity and innovation. The critical question is: how can we shape this area into a successful whole, involving all stakeholders and encouraging innovation?

In this chapter, we will focus on the question of how a university can function as a catalyst in innovation district development. To get a preliminary answer to this question, we have used the available literature, news items and some interviews with representatives of universities in existing innovation districts.

Relevant trends

Many different developments have been recognised that, positively or negatively, elucidate the growing interest in and success of innovation districts. In chapter 4 we have already described several relevant business trends. These trends are mainly about a response to the trend of deconcentration, the search for 'density', a revaluation of the vibrancy and authenticity in (inner) cities and a growing interest in cross-overs. When looking at the possible (anchor) role of a university in an innovation district, the following two trends might be relevant:

The 'opening up' of the university – According to Goddard & Valance (2013) universities have to become civic universities, meaning that they have to turn into an urban 'anchor' institution, being of significant importance to the economy and the wider community life of the cities in which they are based. Or, as Goddard & Valance put it, institutions that are of the city not just in the city. Universities try to do this in different ways by appointing innovation officers (linked to the industry), setting up incubator centres, organising specific education programs for the city population, and so on. The 'opening up' is sometimes also stimulated by taking the initiative to settle in an innovation district or by starting an innovation district by itself.

From triple to quadruple helix - It is not surprising that this interweaving of the university with the city led to a shift of the triple helix concept towards the quadruple helix. It is the cooperation of university, (local) government, firms and inhabitants. This might have to do less with innovation, as far as the local population is involved, and points at – among others – education, continuous learning, living labs and other forms of co-production with citizens. Several authors state that universities should go to or settle next to deprived areas to encourage developments there.

Although these trends can explain the upcoming phenomena of innovation districts, we do not suggest that this is the end of science parks. Science parks will continue to exist, but the concept has to be adjusted to new standards (see chapter 4). The innovation district is just another concept in the realm of innovation areas.

Moreover, it is essential to consider science parks, innovation districts and innovation campuses as focus points within an innovative region. It would be a grave mistake to think that such a cluster or set of clusters will in itself determine the innovation power of a city or region. Also, because too many relevant, innovative firms and institutions are established outside these innovation areas.

The university, the networks and the ecosystem

Given the trends above, a university might choose to move (partly) into an innovation district, which seems to be more open to the city than a campus at the edge of a city. Will that make it easier for a university to become a part of that ecosystem? Let us first have a look at the relationship between a university and a science park. It is often stated that universities play a crucial role in the development and success of the networks and the ecosystem in a science park. Proximity to a university is generally believed to be helpful (if not crucial) to establishing and maintaining a working relationship. 84% of the science parks are within 5 km of their closest university, and 66% are either on or adjacent to the university campus (EC, 2014). These statistics suggest that the proximity of a university is crucial to the development of a science park. With regard to the new concept of innovation districts, the question arises whether an innovation district

can do without a university. Or, the other way around, can a university campus be a good starting point for an innovation district?
A study of six science parks in The Netherlands (Van Dinteren, 2012; see chapter 3) revealed that such a relationship with a university could cover a lot of activities and is not solely limited to knowledge linkages. It even appeared that other aspects/facilities were generally seen as more important by the entrepreneurs established in the science park. The most important are the availability of graduate students, access to libraries and data systems, and the access to laboratories and clean rooms. Only after that come the aspects more directly associated with research such as the opportunities for joint research between the company and the university and the presence of relevant research activities. These percentages are influenced by the fact that, in these science parks, firms are established that do not directly belong to the target group. Admission policy on some science parks in The Netherlands is relatively weak. If we focus on firms and institutions that belong to the target group, these show above-average scores with regard to the appreciation of research activities (relevant to the company) present in the university (96% versus 74% overall), of being able to carry out joint research (89% in comparison to 73%) and of the availability of laboratories/clean rooms (72% versus 51% of the total population).

Proximity, mass and density

The need for a university can be related to the desire of firms and other institutions to be able to consult researchers at the university quickly and informally. On the other hand, how relevant is proximity given globalisation, the internet and other possibilities for rapid exchange of knowledge? Recent studies seem to indicate that proximity still plays a role. Linkages between firms and research institutions function both on the local and global level. Sometimes a university is even criticised for too much global interest. For example, Meric Gertler, president of the University of Toronto, agrees with the criticism that his university focuses too much on international relationships, reputation and rankings than on its community partners (www.universityaffairs.ca/news/news-article/big-city-universities-examine-their-relationship-to-the-cities-in-which-they-reside/).

A study about research outcomes by Dutch CPB (2017) shows that the chance that a company builds on the knowledge produced at a university decreases the further it is from the university. The results of the study suggest that knowledge spill-overs are localised. The size of the effect also depends on the sector and the size of the university. The study is, however, focused on the regional level and is not clear about the impact of small(er) distances.

Andes (2017) states that over the last century hundreds of studies have proved the benefits of density and proximity for innovation and that these findings suggest that knowledge sharing among universities, research labs, and firms exists at the neighbourhood level. Andes does not elaborate on what proximity exactly

means. Still, he shows that the size of the city (mass) and the density of the urban environment play a role, as universities established in that type of environment flourish. He analyses downtown universities in metropolitan areas (the reasoning here is based on numerous economic studies which show that large metropolitan areas experience much stronger positive effects of proximity than smaller cities). In his research, Andes compares the commercial outcomes of research universities located within employment-dense neighbourhoods (e.g. downtowns) in the 100 largest cities to the average research university. He finds that compared to their peers located in smaller towns, suburbs or rural areas on a per-student basis, 'downtown' universities:

- produce 80% more licensing deals;
- disclose 123% more inventions;
- receive 222% more income from licensing agreements;
- create 71% more start-ups.

These outcomes suggest that universities located in dense employment centres of cities achieve more significant commercial impact for their research. Clustering of economic activities does matter and inner cities, where most of the innovation districts can be found or are located nearby, provide the right conditions for such a clustering.

The university and the innovation district: two models

There are two simple models when we look at the possible relationship between a university and an innovation district. In the first case, an innovation district is under development and looks for a university or annexes of a university to complete the picture, as it might be clear that a vital institution or company can be an essential anchor in such a development. It helps to create an image, but it is also an essential node in the local innovation network.

The second option is a university taking the initiative to develop an innovation district next to its premises, or maybe even mixed with its own buildings. The motivation, as described above, is to become a part of the city and not just being located in it.

Model 1 - Katz & Wagner (2014) state "universities are particularly helpful drivers for growing districts; for this reason, many districts that did not originally include universities (…) have convinced universities to build satellite campuses". Initiators of the I.D.E.A. District in San Diego were worried about this development because a few years ago the migration of technology companies to the downtown area had started to take hold. In 2013, 25% of the new downtown leases, many of them tech companies, were executed by companies coming from outside of downtown. To speed up and assure development a corporate leader was needed "who can accelerate the transformation". In December 2016, UC San Diego, a major research university, announced a 6,100 m2 downtown outpost. It is now expected that satellite businesses will surely follow. "As soon as UCSD or one of

the other big academic institutions puts a beachhead downtown, then we'll know downtown has arrived", potential users told Carlson, a CBRE commercial broker active in downtown office leasing (www.ideadistrictsd.com).
In the early days of the well-known Boston Innovation District, its position was strengthened when a satellite campus of Babson College was established. In 2011 this campus was expected to serve "as the academic anchor to help fuel further growth in the Innovation District". "Nobody creates jobs like entrepreneurs, and nobody creates entrepreneurs like Babson," said Mayor Menino. "The inclusion of a top-tier academic institution here in the Innovation District is a key part of the supportive infrastructure we are building and providing to the people and businesses in this neighbourhood. Babson's expertise and partnership undoubtedly will help us fuel even more connectivity and growth across this district." (www.babson.edu/news-events/babson-news/Pages/11915Innovation-District-Welcomes-Babson.aspx.)
In the case of the 22@Barcelona innovation district, companies have been the anchors in the early stage, but nowadays universities seem to have taken over this role. Being a publicly financed university, the Universitat Pompeu Fabra, for example, felt it was obliged to move a part of its activities, especially in the broad fields of communication, to the Barcelona innovation district.

Model 2 - or 'the other way around': the university that wants to become an innovation district. The reasons for this can differ. Offering a pleasant environment to work and study in is one possible reason, but creating stronger links with companies (the entrepreneurial university) is certainly another one. An example is Seattle's University District. This district extends beyond the physical boundaries of the university, which makes the development much more difficult because of the existing neighbourhoods. This raises a conflict between the envisaged development and liveability. The city takes care of good planning, assuring that there will be sufficient affordable housing, instead of gentrification. A light-rail station in the district will help to discourage motor vehicle traffic (www.washington.edu/innovation/).
In the case of Melbourne (Australia) the development of an urban innovation district (MID) is an initiative of the City of Melbourne, RMIT University and the University of Melbourne. Home to 21% of all knowledge sector jobs in Melbourne, the urban innovation district features the central campuses of RMIT and the University of Melbourne, State Library Victoria, Queen Victoria Market, Royal Exhibition Building, Trades Hall and the Melbourne Museum. "Through community events and improved public spaces, MID will provide more opportunities for Melbourne's knowledge workers, researchers, students, business and community organisations to connect and collaborate, creating innovative ideas essential for the city to continue to thrive and prosper. Planning considerations for the area will help innovation flourish and will include upgrades to streets, parks and other public spaces, while at the same time protecting the district's suburban character" (www.rmit.edu.au/news/all-news/2017/aug/melbourne-innovation-districts-launched).

The added value of a university for an innovation district

If in an innovation district it is felt that a university is needed as an anchor, it is assumed that such an institution will be crucial in stimulating innovation, and in creating a scientific, innovative ecosystem. The development of the Boston Innovation District mentioned above shows that such an anchor helps to strengthen the image of the development and stimulates entrepreneurs to choose to settle in the district. But the added value of a university is not limited to companies and other institutions. From the idea of a civic university, a university well embedded in society, there are also (high) expectations about the ability of the university to stimulate social and economic development in deprived areas, as it is often stated that many innovation districts are located near such neighbourhoods. Special (education) programs might help young people (with parents that have no university education) living in these neighbourhoods, offering better opportunities to visit a university. Students at the university can also play a role in these deprived areas as volunteers, supporting people, local schools and organisations. For the people living in these quarters, but also for others living in the surrounding areas, the university can provide access to facilities, such as gyms, meeting rooms, restaurants, library and the like. The university can also organise exhibitions and lectures and can actively participate in local projects, helping to find solutions for specific problems (see Goddard & Kempton, 2016).

It is our impression that, in the literature, particular attention is paid to the relationship of the university with surrounding districts, while in practice it is a relationship with the city, and perhaps the region too. This doesn't exclude that a certain accent can be placed on deprived neighbourhoods.

The added value of an innovation district for the university

Although a university might be necessary as an anchor in an innovation district, the innovation district can also be of importance for the university itself as Bruce c.s. (2015) have described. Being established or having satellites in an innovation district helps research and innovation in universities. The authors sum up many examples (in the United States of America) of educational and research institutions that have moved vital facilities and departments as a means of generating greater innovation output to retain or achieve competitive advantage in their respective clusters and fields. By seeking the best places within their region (or even within other regions), universities want to retain or strengthen their competitive power.

Of less significance is maybe the fact that the settlement of a university (or an annexe) might be perceived by students as an attractive location because of the dynamic environment "where people unexpectedly bump into each other again and again in their daily routines". An environment formed by cafeterias, convenience stores, theatres, restaurants, and so on. As many innovation districts can be found in the central parts of a city, good public transport is guaranteed.

Figure 18: Campus del Poblenau, part of the 22@Barcelona innovation district

Further details from three cases

Besides the desk research, various interviews with representatives of universities were held. Special thanks to the following persons, because they were so kind as to provide us with detailed information about their developments:

- Anna Belchi (Campus del Poblenou, Barcelona, Spain: see figure 18)
- Margaret O'Mara (University of Washington, Seattle, USA)
- Derek McCormack (Auckland University of Technology, New Zealand).

Barcelona and Seattle have already been shortly introduced above. The development in Auckland is at an early stage. Massey University, Auckland Tourism, Events & Economic Development (ATEED) and BNZ are working together to develop a smart innovation district in the northern part of the city, comprising five districts. The goal is to create a highly prosperous, vibrant and liveable community, where aspirational businesses and talented people will want to live and work, produce exportable innovation and collectively build a better future for themselves and their families.

Looking closer at these three examples, it is evident that there are significant differences in the relationship (and its origin) between the university and the innovation district. In Barcelona, the establishment of an innovation district was going on for almost a decade when the Pompeu Fabra University decided to move a part of their activities to this redevelopment area. The university jumped, in a way, on a moving train. The universities in Seattle and Auckland were already established in the neighbourhood that started turning into an innovation district.

These universities were in the heart of a development that seems to be partly autonomous and partly driven by their presence.

So, the Pompeu Fabra University was acquainted with the development of the 22@Barcelona innovation district. Therefore, the university was able to look at the economic profile of the innovation district and decided to move specific activities to the 22@Barcelona district that have strong linkages with the clusters established in the area. The Campus del Poblenou is focused on 'Communication and Information Technologies'. This is not to say that this is the strict focus. It was stated that the combination of specialisation and cross-overs will stimulate innovation. So, the collaboration of the university with other institutions and companies is not limited to media and computer technology, but also involves other clusters such as medical, energy and design. The combination of specialisation and cross-overs is emphasised by the other interviewees as well. In Auckland one perceives the cross-clustering a characteristic of innovation districts, giving to new patents, business start-ups, and industry involvement, thus also effecting an increase in employment and wages.

In Seattle the University of Washington was surrounded by a university-oriented neighbourhood in its immediate vicinity before the concept of an innovation district was even mentioned. Its huge potential became apparent only a few years ago and since 2012 the government and university have been working closely together to manage a more robust and future-oriented change. The commitment of the University of Washington to build a better U(niversity) District is driven by:

- continuous, meaningful collaboration with the City and community partners;
- learning from the experience of the most dynamic neighbourhoods around the region, the nation, and the globe; and
- fostering growth that is complementary to other parts of the city and region, adding to the overall economic and cultural dynamism of the State.

The case of Seattle also shows the possible disadvantages of spontaneous development. In Seattle, it became apparent that walls along and overpasses across 15th Avenue had created a physical barrier between the city and campus. The new development plans provide an extraordinary opportunity to knit together campus and city, according to our interviewee.

Like Seattle, universities in Auckland were already established in the area that has become an innovation district. Since its transition to a university in 2000 Auckland University of Technology saw its surrounding neighbourhoods change, which might have been partly related to the presence of the universities. The same goes for Massey University, established in the same part of the city. Recognising that this part of Auckland was in the midst of constant residential and commercial property development and growth, Massey University held a symposium in 2015 to consider the future of Auckland North. This symposium demonstrated a clear interest in and excitement for bolstering an innovation district and engendered the support of city leaders, university leaders and researchers, various business

owners and entrepreneurs. This interest led to the 'Grow North' initiative that focusses on establishing a (more formal) innovation district. Clusters of innovation are already beginning to emerge organically in Auckland North.

For the universities of Seattle, Auckland and Barcelona, it is evident that they contribute significantly to the success of the innovation district. Although it is difficult to determine its exact benefits, there seem to be some common takeaways:

- being partners in joint innovation projects with companies established in the district (not excluding others, of course);
- providing facilities and equipment to support company R&D projects;
- foster start-ups by setting up incubators;
- offering educational programs to the inhabitants of the surrounding neighbourhoods, especially in the case of deprived quarters, to enhance education levels and lower the threshold to the university (inclusion and engagement; sometimes also relevant to the city as a whole);
- creating positive urban change in the cities they are located in, especially in the direct vicinity of the innovation district: more varied housing options (enhancing diversity) and amenities, and engagement in neighbourhood revitalisation.

When it comes to the benefits of being located in an innovation district, all interviewees agree that the university benefits too. Most important advantages for the universities are:

- understanding the needs of society/companies and adapting the education program to it;
- the interchange of staff and students across porous boundaries. Innovation districts can enhance student experiences, and stimulate research and creative activity among the university staff and students;
- having close working links with start-up and more mature companies in innovation districts enabling the flow of graduates into employment and cooperating on joint R&D projects;
- the possibility of neighbourhood redevelopment to expand the campus footprint.

Finally, according to our interviewees, many factors determine the success of an innovation district development. The following starting conditions were stressed:

- having a strong basis: innovative firms present and willing to engage in collaboration, an entrepreneurial university focussed on innovation, the active contribution of venture capitalists and other investors;
- taking the very long term as a starting point, but also focus at quick wins;
- creating a vision and strategy that is shared with and supported by investors, companies, universities, government, inhabitants and other stakeholders.

And especially concerning the university:
- a pro-active strategy by the university for open collaboration with business and industry;
- an active commercialisation office or company within the university;
- active support for student entrepreneurship plus entrepreneurship training for staff and students;
- flexible commercialisation policies to enable easier spin-out of new ventures or licensing of Intellectual Property;
- having the university commercialisation office well linked to relevant industries and product sector experts who bring IP ventures to the right know-how and seed capital in the Innovation District.

Preliminary conclusion

In an innovation economy networks are essential. Large innovative companies and universities can build the webs connecting these networks. Although we have all the opportunities to establish worldwide networks, research suggests that proximity is still important. But what is proximity? Is that on the neighbourhood, the city or the regional level? What about smaller cities and larger ones? 66% of all science parks are established on the campus of a university. That seems to suggest that short distances are relevant. And, as we have seen, that it is not just because of networks, but also about facilities and the like, we could state that proximity also helps to create that dynamic environment that students, innovators and companies are looking for. In that respect, it is also interesting to notice that universities in dense areas flourish.

Given these outcomes, one could suggest that it is relevant to have a university or an annexe of a university in an innovation district, as distance does matter. However, there are as yet no hard research outcomes that make it clear that the success of an innovation district is dependent upon a university. Apart from that, the cases described here suggest, in short, that the establishment of a university or annexe can help the development of an innovation district by creating trust and contributing to a positive image of the development.
It is also interesting to note that universities themselves believe in the concept. Innovation districts can try to attract a university. Still, we have seen that there is also another model in which the university wants to develop an innovation district on its premises or adjacent to it. In our opinion, the interviews we have held confirm the outcomes of our desk research.

Although it is all based on circumstantial evidence, our research seems to suggest that the establishment of a university (annexe) can be a significant anchor in the development of an innovation area. We like to invite our fellow researchers to gather more hard information on the linkages between a university and its innovation district. What does proximity mean in terms of (kilo)meters? Keep in mind that proximity not only refers to exchanging information but is also relevant with regard to other aspects such as availability of students, facilities and the like.

7. Managing the ecosystem [6]

As stated before in other chapters, the shifting away from a real estate development towards stimulating innovation has changed the management of science parks. It is not about managing buildings, but managing a community of people working on innovations. Due to its character managing an innovation district might be somewhat different from managing a science park or a co-innovation park. The management of such a development is still critical, though functional blending of activities is a relatively new element in this concept and might ask for a somewhat different approach. Due to the functional mix, other parties than the usual ones might become involved, such as the inhabitants of the area. Moreover, the link with a university is generally less intense, though this can be partially overcome by establishing a 'branch'.

There are alterations in the science park concept over time and this has led to changes in the way these estates are managed. Such modifications will continue, for example, due to the somewhat isolated geographical position of many science parks, often at the edge of a city. That poses questions about the embeddedness of science parks (and probably also co-innovation parks) in the region. Maybe the region is a better scale: an innovation region with multiple focal points (innovation areas) and a network of companies and institutions which are located in those innovation areas and elsewhere in the region. That poses questions about the way innovation areas and their linkages with the region are organised. It also raises the question of whether management at the regional level is needed. And in the next step one has even to consider the global level. Thanks to travel options, telecommunications and the like, regions are included in worldwide networks through the process of globalisation, and innovation parks become hubs in the global knowledge network.

This chapter will discuss some of these changes, using a simplified model of changing innovation area concepts and changing management activities.

Changing concepts, changing management

Figure 19 sketches the development of the innovation area concept over the past decades, also showing the emergence of innovation districts and the growing interest of embedding these concepts in regional and worldwide networks. It is an ideal-type image which will rarely apply to a specific innovation area. The figure mainly shows that currently much more emphasis is placed on networks and (therefore also) on the regional and worldwide embedding of an innovation area.

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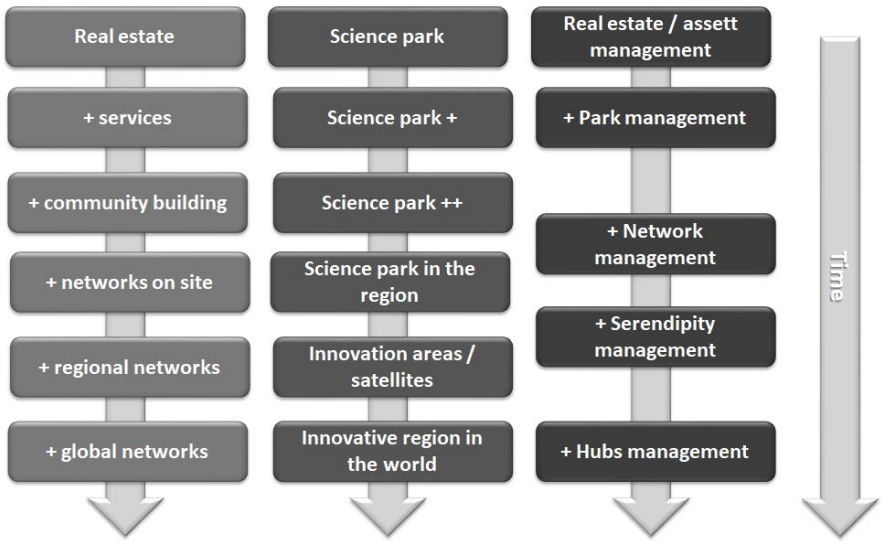
[6] Based on: Jacques van Dinteren, Laurens Tait and Frank Werner (2017), Paper for the 34th IASP World Conference in Istanbul, 26-29 September 2017.

The more complex these networks are, which is also related to the geographical scale, the more critical the management of the ecosystem.

Figure 19: ideal-type development of the innovation area concept and its management



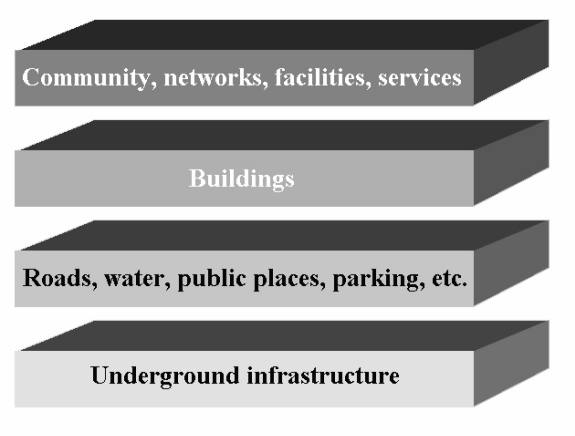
There are many ways to manage a company, and there are also many ways to run an innovation area. When analysing management concepts, ownership is an important starting point. A survey of IASP in 2012 (European Commission, 2013) shows that the public sector dominates: 55% of science parks in Europe are owned by public parties, mainly local government, public universities and regional government. This can be a mix of public parties. 15% of the science parks are privately owned (private universities and foundations, and private companies) and 31% of the science parks have mixed ownership. In this latter case, local government, public universities and private companies dominate.

The survey mentioned above relates ownership to land, sites, infrastructures and buildings. If perceived in such a way managing a science park doesn't differ from managing an industrial estate or a business park. This focus on the physical aspects of a science park was typical for the first decades of the science park concept, as stated earlier. In that stage, the specific characteristic of a science park was a physical clustering of a particular target group; in this case, a group of companies focussing on research and development. During the years, the insight grew that the real economic asset of a science park is in the linkages between companies, institutions and a university. The conclusion was that successful science park management needed an extra layer. The management of a commercial estate will focus on infrastructure underground and the surface and will take care of buildings and the built environment (figure 20). But the added

value of an innovation area is in the 'software' as an extra layer. That distinguishes it from a regular industrial site or business park:

- management of the networks between companies, institutions and a university;
- management of the facilities for companies, institutions and a university;
- management of the services for the community (the people who work on the site).

Figure 20: physical and socio-economic layers as individual and interconnected components of an innovation area



The left column of figure 19 shows how the management of innovation area concepts has adapted to evolving concepts and the shift from real estate towards the community (to put it briefly). Today many science parks in the western world are 'halfway', although many differences exist between countries and regions. There is a focus on creating networks between the parties in the estate and management also takes care of a high-quality environment for the employees to sustain creative processes and to attract and keep a critical and highly educated workforce, the community. When looking at creating the community joint festivities, sports events and having a drink together should help to develop this. Part of this is also the quality of the working environment.

Although building a community is perceived today as an essential part of an innovation part, the most crucial is creating the networks between companies and institutions. Matchmaking, organising seminars, support with patent applications are all matters which are part of the extensive service package which innovation area management offers.

So, today, there are many different management activities: area and real estate management, network and community management, but also facility management, asset management, etc. All these management activities generally

have different stakeholders. This can cause problems. How can these different fields become properly connected and organised coherently? Is it possible to have one organisation that can do business on behalf of all partners? It is of course (relatively) easier if only one owner manages the science park. In The Netherlands that is the case with the High Tech Campus in Eindhoven. Other science parks show a somewhat more complex organisation.

Figure 21: network management benefits from good, interaction-oriented architecture (Plus Ultra I building, Wageningen, The Netherlands.
A project by Proof of the sum and Kadans Science Partner)

Managing science parks in The Netherlands

Although there are many differences, one can generally state that many of the Dutch science parks now are in the stage of further developing the community and building networks. The question who manages the science park is relevant here because in general, there are two or more stakeholders. The exception is the ***High Tech Campus in Eindhoven***. The starting point for the Philips High Tech Campus were the high-quality laboratories of Philips (NatLab), the trend towards open innovation and the feeling by management that the company had to stimulate the regional economy. This latter aspect had to do with the decision by Philips to move their headquarter from Eindhoven to Amsterdam in 1998. In a discussion with the government, the idea of an open innovation park came up to compensate for the loss (although only 300 jobs were involved). Initially, the park was managed by Philips, but in 2008 Philips decided to sell the campus to focus on their core business. In January 2012 Philips established High Tech Campus Eindhoven Site Management B.V. (without the name Philips). This organisation

takes care of daily management, including marketing and promotion. In that year a Dutch investor Chalet Group) bought the campus and today all management activities are still in one hand. However, some specific and unique facilities are still owned and managed by Philips.
New tenants in HTCE get two types of contracts with two organisations affiliated to Chalet Group: a Service Level Agreement (SLA) with HTCE Site Management and a Lease Contract with Calittum HTCE for rent and parking space. The first one covers three types of services: obligatory collective services that are site related (e.g. energy, ICT, infrastructure, etc.); optional communal services if needed; and optional services that are free choice and taken via HTCE Site Management (Curvelo Magdaniel, 2016).

TU Delft Science Park once started in 2005 as a predominantly real estate project by property developers Bouwfonds MAB and ING Real Estate: Technopolis Innovation Park (120 ha). University and municipality took care of the financial aspects of land development, including financial risks. The developers took care of the master plan and the investments needed, would buy the land from the owners and develop the buildings. All parties worked together in a project organisation, but due to the lack of expertise in the development companies, the project failed and the university took over. The exclusive cooperation agreement between the landowners of Technopolis and ING Vastgoed and MAB / Bouwfonds was disbanded. Today the university has the lead and is looking for the best form to manage the development. The university also offers space for companies in their buildings. Municipality and university work together on the marketing of the science park in 'Delft Technology Partners'.

So far for the involvement of real estate companies. One is successful, but another wasn't. In The Netherlands property developers are reluctant, and if a developer is interested the question often is how to convince investors. It is a niche market. If developers or investors don't feel comfortable, projects will not start. Even when it is only about buildings, it is sometimes difficult to get the project going. Specialisation, however, helps as is shown by the successful developments of Kadans Science Partner. A fascinating aspect is that this developer/investor combines a real estate development with the management of the building, as the building remains in the portfolio of Kadans. Kadans provides a total package of services, including workspace facilities, coaching, advice, financing and access to its network.

In the case of the ***Amsterdam Science Park*** the estate is owned by municipality and university together. However, it is a patchwork of ownership. The estate of the Dutch Scientific Organisation (NWO) covers the northern part of the science park and has its own park management. Municipality and university sell the available land for the same price. Both took care of the urban master plan, which is supervised by the municipality.

The construction zones are subject to a building code that is characterized by a continuous and varied network structure that establishes a system of successive public and semi-public spaces. Situating communal amenities at junctions fosters concentrations of public activity. Instead of standing like isolated jewels in the landscape, the buildings 'fold' themselves around the courtyards and interweave with adjacent buildings. In this way, interactivity, knowledge exchange and cooperation among the companies in the area are stimulated. This creates a base for successful social and economic interaction through stimulating a 'xenogamy' of various talents, ideas and insights.

Companies that want to establish on the park go to the central organisation which takes care of the first contact. Contracts are handled by the landowners and the municipality checks if the company fits into the profile as described in the spatial plan. Daily management is carried out by the Science and Business Organization of Amsterdam Science Park. This is the central and joint organization of the three founding partners, which are the city of Amsterdam, University of Amsterdam and NWO. These three are in the board of directors and are joint by four other representatives of companies and institutions on the park. The main goal of the S&B organisation is to connect entrepreneurship, education and research and to connect Amsterdam Science Park with its external partners. The main focus points of the management organisation are:

- acquisition & retention;
- valorisation & entrepreneurship;
- corporate communication;
- functions & facilities;
- internal & external relations.

It all works well together, but it is said that an improvement can be achieved if the land is in one hand and competencies are concentrated, both preferably within the existing management organisation.

The same thoughts can be heard at ***Utrecht Science Park***. Stakeholders are the Utrecht University, the academic hospital and the Hogeschool Utrecht (College). Provincial and local government is also involved but not an owner of buildings or land. Daily management is carried out by Foundation Utrecht Science Park. Several parties own the land. That includes parking spaces, but the fares for parking are not synchronised. Interested companies and institutions can have a site on the basis of a land lease. Available land is sold by the university, but in generally interested parties start the discussion with the foundation.
In a project carried out in 2016, the joint conclusion was that too many parties were involved in too many aspects of the science park. The ambition is to get a slim and flexible organisation, which will be the existing foundation. The question is; however, which tasks can be handed over, under what conditions (mandate). The joint ambition is

- a shared vision regarding the development of the science park (urban development, economic impact, target groups, growth strategy, etc.);
- joint park management;
- joint mobility management;
- joint parking management;
- cooperation in offering services to the community;
- marketing and acquisition of the target group, including a strict admission policy.

In the vision, attention has to be paid to the question of how costs, profits and risks can be distributed among the stakeholders. Whatever the organisation, the stakeholders are all customers of the daily organisation (the existing foundation). A stakeholder analysis was determined to find out which stakeholders are involved and the degree of the influence they can get. With regard to the area development, each party retains his responsibilities as currently laid down. Joining forces in this field will be discussed in a later stage.
Looking at Utrecht and Amsterdam, it is clear that there is a feeling that the governance of a science park should be organised in such a way that all relevant tasks are carried out by one central organisation. This suggestion can be heard in several other places in The Netherlands. Managers involved are very much interested in (relatively) simple organisations as have been set up for Oxford Science Park or Surrey Science Park in the United Kingdom. So, during a project for Utrecht Science Park the question rose: what can be a rather general governance model that takes every stakeholder seriously, but makes one central, coordinating management office possible? How to optimise governance?

Optimalisation of governance

The starting point is that in today's innovation areas the development of a knowledge network of companies and institutions is essential (including facilities). The same goes for the creation of a community (which is more focussed on personnel, offering services and a top working environment). All together: the ecosystem. Of course, one also needs an attractive area and buildings that suit the needs of companies and institutions that are focussed on innovations. One assumes the following, simple line of reasoning: development strategy → ecosystem → physical development. It cannot be denied that first of all the 'guests' in the estate (companies, institutions, university, leading innovative company, others) are central (figure 22).

The scheme makes a distinction between the socio-economic system (blue) and the physical, spatial system (brown) which creates the conditions for the socio-economic system. The two main activities in the socio-economic system will be carried out by one organisation, taking care of daily management and strategies and is controlled by a supervising council in which all relevant stakeholders are represented. That includes the stakeholders responsible for the area and the buildings. Now we have to add government. First of all, because the plans have to

fit into the legal plans of (local) government. Also, the university, for example, will have its own policy that can be relevant for the development. Now we have a model that is recognisable in several science parks in The Netherlands (figure 23).

Figure 22: in search for a governance structure – starting position

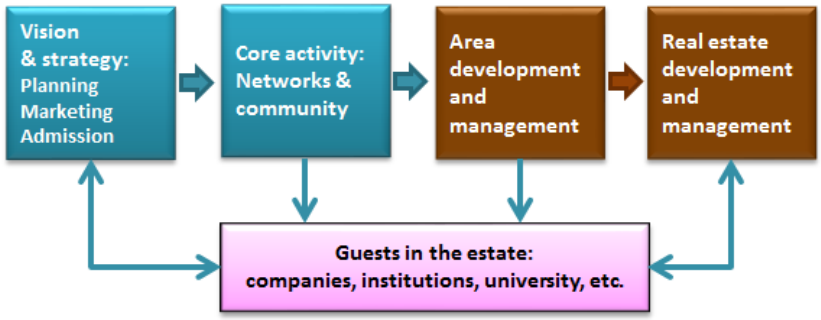
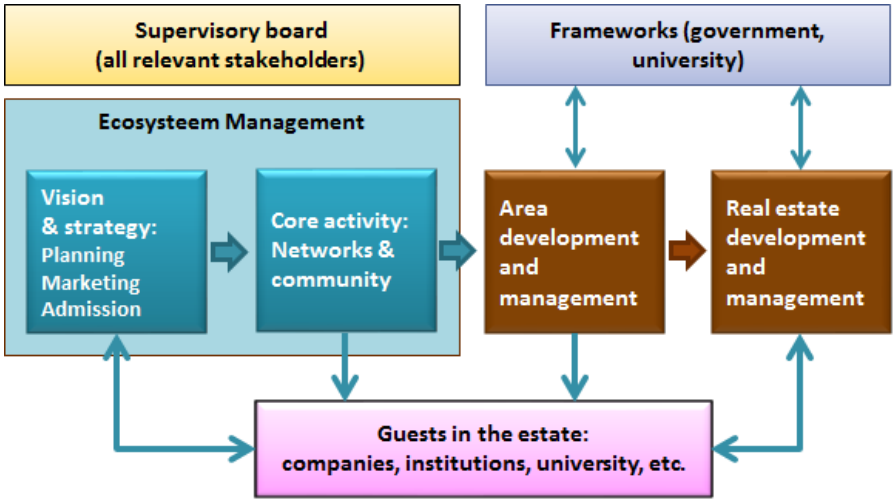


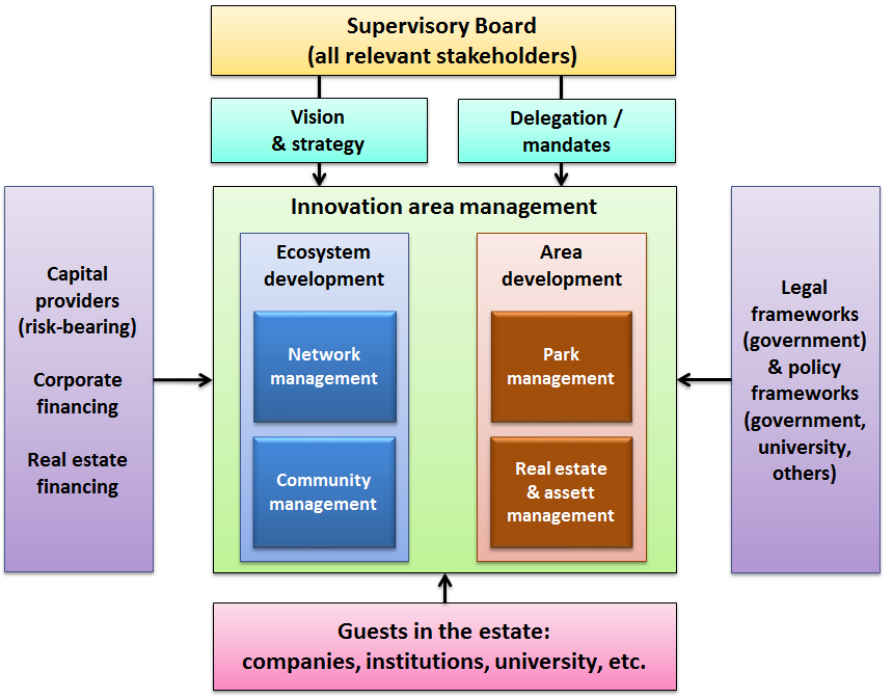
Figure 23: the extended scheme



Problem is, however, that daily management has no direct control over the physical environment. In many of the Dutch cases, this doesn't hamper the functioning of daily management. However, it is often said that it makes coordinated management of the estate less easy and asks for more coordination than would be necessary. Therefore, the next step in the model is to give the ecosystem management organisation the mandate to take care of the area and real estate management (figure 24). To complete the picture, we can add the linkages between the central management organisation and external parties that

offer financial solutions, which are of great importance for the companies and institutions working in the innovation area. Stakeholders in the Utrecht Science Park are now together exploring the possibilities for such a model.

Figure 24: final scheme



New themes in management

The ideas about managing an innovation area have changed over the years. It would be simple to think that it would stop here. New developments are coming up, like serendipity management or changing the introvert character of science parks and co-innovation parks and making these estates focal points in a regional network.

Serendipity management

A new element in managing the networks of an innovation area is creating or stimulating serendipity. Essentially serendipity management comes down to: how can people with different backgrounds be connected and collaborate, to enable new insights and ultimately new products to be developed through "pure coincidence" (= serendipity)? This may manifest itself in a building in which the concept resembles all kinds of creative workplaces which are popping up all over the place in which flexible, playfully designed spaces with all sorts of facilities and short lease periods are available for creative people, entrepreneurs and others.

An example of this in a science park is the NetWork Oasis at the Joensuu Science Park (Finland). This concept will only become truly interesting when the idea of serendipity is combined with a method in which different researchers and product developers with different characters and backgrounds are brought together. This is done via a step-by-step process, including training camps and work sessions to build teams, which will then focus on the development of a new product (see Kakko, 2013). Such a way of working has consequences for the management method, as shown in table 6. Not that this will make project management obsolete. The schedule indicates that by including networking, and particularly from the perspective of serendipity, other skills are required from managers and involved parties.

Table 6: the difference between project management and management of serendipity (Kakko, 2013)

Characteristic	Project management	Serendipity management
Approach	Project	Journey / exploration
Type of innovation	Directional	Intersectional
Organisation	Fixed in the beginning	Flexible
Focus	Effective process	Best possible result
Structure	Closed innovation	Open innovation
Mission	Goal decided in the beginning	Vision decided in the beginning
Competence search	While defining the project	Training camp approach
Resources, time schedule	Fixed	Flexible
Management style	Command and control	Connectivity and collaboration

Regional embeddedness

A science park can only develop and be successful if it is situated in an innovative region. So, it is logical that a science park, but also other innovation areas, is well connected with its region. An innovation area needs regional embeddedness. An innovation area is nothing more than a spatial cluster of R&D related activities within an innovative region. And even then: what is a region when we are talking about innovation? The best innovation areas are or are becoming hubs in large, global networks, thanks to enhanced telecommunication and travel options.

Companies and institutions can establish linkages in the regional network. Part of the game can be the creation of satellites by an innovation area. As an innovation area has reached the limits of its growth, occasionally ‘branches’ are developed in other parts of the region. One out of three members of IASP already has one or more branches. In The Netherlands none of the innovation areas has branches. In 2016 the Utrecht Science Park was the first one to think about establishing satellites because the park itself is almost fully occupied. A project has been

carried out to find out what the best locations are. Two branch types were distinguished:

- development cluster: applied R&D and development of products based on the results of basic research;
- testing cluster: laboratories, pilot plants and the like.

After the first selection of 37 locations, 11 were investigated in more detail. 14 variables, grouped in three main dimensions, were used to test the suitability of these possible satellites:

- (spatial) quality of the location and companies present (availability of sites and buildings, representability of the buildings, availability of services, quality of public space, other companies present);
- reachability (travel time to Utrecht Science Park by car and by public transport, time to reach a motorway, time to call a railway station);
- development potential by local government (legal cooperation, welcoming attitude, willingness to invest, park management, strict admission policy).

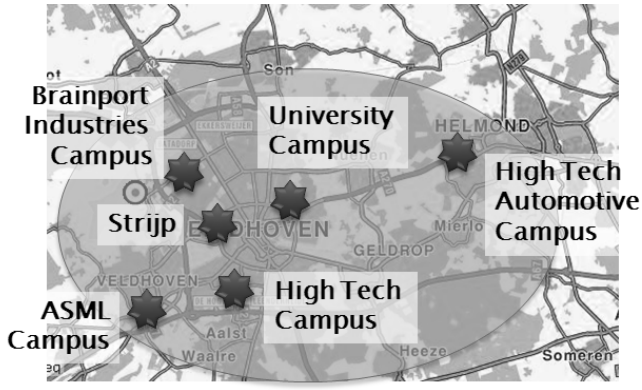
To test the stability of the outcomes, two sets of weighted variables were used, which had no significant impact on the results. Utrecht Science Park now starts to use a nearby complex as its first satellite. The other selected sites are under further investigation.

With or without branches, larger regions can have several innovation areas within its borders. An interesting example in The Netherlands is the Eindhoven region (figure 25) which has a mix of co-innovation parks, science parks, university campus, so-called creative factories (a cluster of creative or innovative small firms in an old factory). To profit from such a constellation and in general of an overrepresentation of innovative companies just innovation area management will not be sufficient. Regional leadership is needed to link innovation companies, institutions and innovation areas. Such strategic regional cooperation between all relevant parties is also a good starting point to connect the region to global networks and become a hub in these networks (some information on networks on a larger geographical scale will be presented later on).

Regional cooperation

The combination of different types of innovation areas with regional cooperation between parties involved has made the Eindhoven region a key player in innovation and global innovation networks. The Eindhoven region promotes itself as Brainport. The main goal of Brainport management is not the development of innovation areas but is achieving economic growth. The focus is primarily on innovation networks and the business environment that is needed to develop and sustain these networks. There is no direct link between the management of the innovation areas and regional governance.

Figure 25: Eindhoven region (The Netherlands) as an example of an innovative region with several focal points



The region is now working on a new strategy: Brainport Next Generation to be able to adapt to new developments. They will move towards a Multi Helix model which also involves citizens, customers, consumers, investors, designers, artists and corporations. It is expected that by broadening the scope faster implementation and an accelerating rate of innovation will be possible. Brainport wants to achieve breakthrough projects and 'living labs' will be set up by strong consortiums of innovative companies, knowledge institutions and social partners.

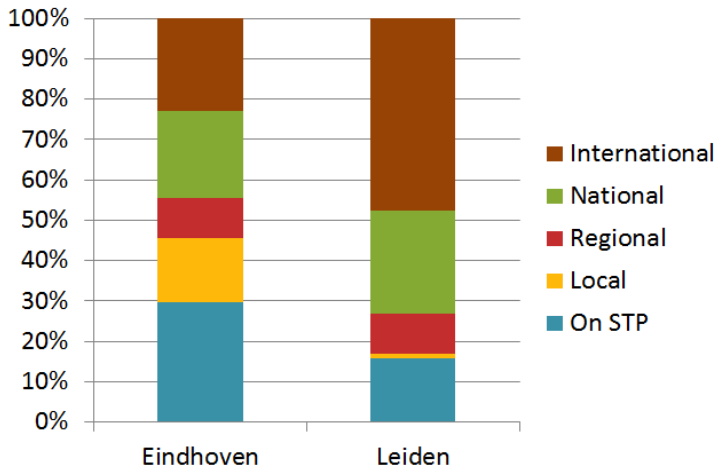
Another example of regional economic cooperation is Science Port Holland which was founded in 2008 and is a regional partnership of the municipalities of Delft and Rotterdam and the Technical University of Delft. Together they worked towards the realization of an attractive business environment within the region Delft - Rotterdam for knowledge-intensive companies. One of the tasks of Science Port Holland was the development of five innovation areas. Today the name of the organisation has changed into InnovationQuarter, and there is no longer a focus on developing innovation areas. The focus today is much more on the regional-economic aspects of innovation. “The mission of InnovationQuarter is to strengthen the regional economy by supporting and stimulating the innovation potential of the area. In close cooperation with all major corporations, educational and research institutions - like the Erasmus University Rotterdam, the Delft University of Technology and Leiden University - and government organisations, InnovationQuarter supports technological developments, encourages entrepreneurship and invests in start-up companies.”

Hubs in global networks

At the regional level linkages between companies and institutions are easy to establish. The good functioning of regional networks, together with other factors (such as labour market, infrastructure, living environment, etc.) can make a region and its innovation areas a success. Although these regional networks or

ecosystems are crucial, most important are the higher-level networks: national and international, which are in the first instance determined by the linkages of individual companies and institutions. Information on innovative developments is such a valuable asset that in fact distances do not matter. Today worldwide communication has become so easy that innovation often happens on a global scale. “The innovation activities are becoming borderless, yet interconnected. Thus, the future success of innovation ecosystems is measured increasingly in the abilities of innovation actors (and core organisations) to connect and manage talent, partnerships, clusters and practical innovation processes – in combining the local knowledge base into the global innovation power grid” (Launonen and Vitanen, 2011). In a survey among entrepreneurs established on Dutch science parks 64% acknowledged the following statement: “If it is about really crucial knowledge for my business, distant is no issue. If necessary, I will travel to the other end of the world to gain this knowledge”. Results from the same research project seem to suggest that size and constellation of innovation areas seem to play a role in the linkages and the intensity with which an innovation area or a region is taken up in global networks. Leiden Bioscience Park in the western part of The Netherlands is a relatively stand-alone development in its region, whereas – as shown before – the Eindhoven region has several innovation areas and strong regional cooperation of stakeholders involved. It is interesting to see that the companies in Leiden Bioscience Park are much more interested in global linkages than Eindhoven is. In contrast, the companies established on High Tech Campus Eindhoven show strong local and regional linkages, demonstrating the strong regional network (figure 26).

Figure 26: the regional focus of companies on two Dutch science parks: High Tech Campus Eindhoven and Leiden Bio Science Park (STP = science or technology park



To conclude

It must have become clear that buildings are no longer the central aspect of science parks and – more broadly – innovation areas, but that community building and networking are essential. This distinguishes this concept from industrial parks, business parks and office parks. Which doesn't alter the fact that ultimately the businesses and institutions located in the innovation areas also need a roof above their heads. Because of this, specific requirements can be placed on buildings, particularly from the desires for community building and networking. For instance, pedestrian flows, the creation of meeting points, the concentration of catering and restaurant facilities where pedestrian flows meet, creative work environments, etc. For the successful management of a science park, it is crucial that the different layers in the social-spatial structure of a science park are recognised and are connected: the infrastructure, the buildings and the networks. Therefore, an interdisciplinary set up of the management team is an absolute necessity.

In light of the developments outlined here, it is evident that innovation areas should be developed in accordance with a modern plan. They have to be embedded in the regional economy and must be part of broadly set up innovation programs. All of that in an attractive spatial setting with real estate optimally facilitating this specific way of working. Such an approach can only be successful if these developments are managed from an integral management philosophy. It concerns not only the management, though also the nature and the design of the buildings, the quality of the surroundings and the possibilities for meetings etc. The older science parks and co-innovative parks are not sufficiently geared to do this. If they want to keep up with the increasingly faster-paced developments in the area of innovations, a physical and functional redevelopment will be required, including a reorientation of the management.

IADP in the picture

IASP World Conference, 2017

IADP excursion to Reading and London, 2019

IASP World Conference, 2017

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Em. prof. dr. Jacques van Dinteren (1952) is co-initiator and president of the Innovation Area Development Partnership. In his research into innovation areas in The Netherlands and abroad, he focuses mainly on the spatial-economic aspects and the management organisation. His strong preference is for close cooperation with other disciplines. In his view, only such an interdisciplinary approach can lead to strong projects, given the complex nature of innovation areas.
He has worked at the Radboud University of Nijmegen, the University of Groningen (both in The Netherlands) and at various consultancy firms, partly in management positions.

Paul Jansen MSc (1976) is co-initiator of the Innovation Area Development Partnership and Associate Director at Arup. Over the last 20 years he has contributed to the development of areas of innovation in countries around the world. He strongly beliefs in a solid socio-economic basis when starting a new area of innovation. In his opinion, real estate, infrastructure and public space are facilitating factors. In his projects he emphasizes the importance of a strong business case, as the result of a complex triple helix play with mixed ownership and finance structures.

The Innovation Area Development Partnership (IADP) was founded in 2016. Consultancies, investors, design agencies, financial advisors, governments and managers of innovation areas form a mixed group within this entity.
The IADP has a twofold objective; create & share knowledge and connect the Dutch/Belgium network of like-minded professionals. Activities are about shared research projects, knowledge exchange and excursions to areas of innovation. Knowledge is also shared with a wider audience by engaging them in the IADP activities, giving lectures, writing articles and books.

IADP
Innovation Area Development Partnership