

Amsterdam University of Applied Sciences

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Published in:
International Journal of Knowledge-Based Development

DOI:
[10.1504/IJKBD.2017.10003161](https://doi.org/10.1504/IJKBD.2017.10003161)

[Link to publication](#)

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Citation for published version (APA):
Carvalho, L., & van Winden, W. (2017). Planned knowledge locations in cities: studying emergence and change. *International Journal of Knowledge-Based Development*, 8-2017(1), 47-67.
<https://doi.org/10.1504/IJKBD.2017.10003161>

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Planned knowledge locations in cities: studying emergence and change

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Abstract: This paper puts forward a conceptual framework to analyse emergence and the development of planned knowledge locations in cities (science and technology parks, creative factories, knowledge hubs, etc.). It argues that the study and the practice of developing these precincts can benefit from explicitly considering the broader territorial context, the time dynamics and the co-evolutionary processes through which they unfold. The advantages of such a framework are illustrated with the support of two European knowledge locations: Arabianranta (Helsinki, Finland) and Biocant (Cantanhede, Portugal).

Keywords: knowledge locations; science parks; co-evolution; knowledge precincts; Arabianranta; Biocant.

Reference to this paper should be made as follows: Carvalho, L. and van Winden, W. (2017) 'Planned knowledge locations in cities: studying emergence and change', *Int. J. Knowledge-Based Development*, Vol. 8, No. 1, pp.47–67.

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1 Introduction

The study of knowledge-based development has been long looking at cities as important loci for innovation and knowledge advancement (e.g., van Winden et al., 2007; Yigitcanlar et al., 2010; Carrillo et al., 2014). On the one hand, physical and relational proximity are enhanced in cities, facilitating complex processes of knowledge creation, re-combination and diffusion (Storper and Venables, 2004; Rodríguez-Pose and Crescenzi, 2008); on the other hand, the heightened speed of knowledge and innovation has been shown to bring significant challenges, among others, to urban economic renewal (Storper et al., 2015). Hence, steering fluid interactions between knowledge and the economic-base of places became a key issue in the knowledge-based economy (van Winden, 2010; May, 2011; Romein et al., 2011; Yigitcanlar, 2011; Lönnqvist and Laihonen, 2013).

One of the most frequently used policy tools to enhance these interactions is the development of knowledge precincts (Yigitcanlar and Bulu, 2016) or *knowledge locations*, i.e., planned area-based initiatives aiming to agglomerate knowledge intensive activities in a designated area or city district (van Winden et al., 2013). Examples include the development of science and technology parks; innovation hubs; science campuses; creative factories, among others. Knowledge locations are often expected to enable synergies among co-located firms, knowledge institutes and other organisations, facilitating the sharing of facilities and knowledge inputs (van Winden and Carvalho, 2015, 2016). From the perspective of cities and regions, there are heightened expectations that knowledge locations will contribute to un-lock new economic growth paths, attract investment, talent and knowledge workers, improve a city's image and physically regenerate old city areas (e.g., Carvalho, 2009; Ratinho and Henriques, 2010; Pancholi et al., 2015; Miao et al., 2015; Vale, 2015). Beyond western economies, knowledge locations and other types of complexes have been also growing fast in Asia and Latin America, pursuing similar objectives (Sarimin and Yigitcanlar, 2011; Rodríguez-Pose and Hardy, 2014; Silva and Forte, 2016).

Despite the promises, several studies on knowledge locations are critical about their true achievements. It has been argued that too many of these locations have turned into 'high-tech fantasies' and pure real-estate businesses, unable to deliver up to its promises (Massey et al., 1992; Miao et al., 2015). Some commentators suggest that failure has been associated with grandiose promises, detached from a region's socio-economic context; others argue that their proponents failed to adjust the location's concept over time, making locations unfit to changing economic and political contexts (e.g., van Winden et al., 2013). Yet, a limitation with most studies is that they overlook spatial and time dynamics. Knowledge locations are often analysed in isolation from the complex socio-economic, industrial and institutional dynamics of their cities. Moreover, most studies look at locations at a specific point in time and neglect how actually knowledge locations emerged and develop over time and how their designs and visions changed in reaction to multiple pressures.

This paper proposes a conceptual framework to analyse and understand the emergence and development of knowledge locations in time and space, grounded on literature from economic geography, urban studies and planning. It argues that the study of knowledge locations can benefit from analyses that explicitly take on board:

- 1 the production-innovation and policy-planning systems of their cities
- 2 consider location's development as a co-evolutionary process between the urban context, governance arenas and the location itself.

The paper is thus structured along the following research questions:

- 1 How does the emergence and development of a knowledge location relate to its spatial-economic context?
- 2 How does a knowledge location's ambition and features change over time?

On the one hand, emergence is conceptualised as resulting from the coupling of interests of individuals and organisations, which are deeply influenced by the character of the region's production dynamics and planning traditions; thus, it is argued that it is misleading to think of knowledge locations as the sole result of the action and free will of visionary (or short-sighted) decision makers. On the other hand, it is argued that visions and designs for knowledge location are not once and for all, but evolve along multiple rounds of decision making. Again, those changes do not necessarily result from good or bad planning, but from the coupling of:

- 1 external-to-the-location changes and actor's self-organisation with
- 2 the progressive co-evolution between the location and its spatial-economic context.

Thus, their design and development does not result of a linear, well-defined set of actions. These arguments are illustrated with processes of emergence and development of two knowledge locations in Europe: Arabianranta (a well known creative district around the theme of 'art and design') and Biocant (a science and technology park specialised in biotechnology).

The paper is organised as follows. Section 2 puts forward a conceptual framework and theoretical propositions to understand the emergence and development of knowledge locations. Section 3 briefly presents the two case studies and methodological considerations. Section 4 and Section 5 illustrate the conceptual framework with empirics from the two case studies, followed by a discussion (Section 6). Section 7 concludes with policy implications.

2 Conceptual framework and propositions

2.1 Knowledge locations in context: understanding emergence

Despite the contemporary attempts to plan new knowledge locations 'from scratch; (Carvalho and Campos, 2013; Carvalho, 2015) and 'silicon somewhere' (Hospers, 2006), most knowledge locations do not emerge in vacuum. They are influenced by the socio-economic and institutional characteristics of the places (cities, regions) in which they are planned. It can thus be expected that the way knowledge locations emerge and unfold – i.e., their envisioned knowledge specialisations, physical profile and development dynamics – to be strongly influenced by their specific spatial-economic context. This context can be understood as encompassing two interacting systems of actors, networks and institutions namely:

- 1 a production-innovation system
- 2 a policy-planning system.

The notion of ‘system’ here refers to the presence in place of a set of actors (e.g., entrepreneurs, firms, knowledge institutes, supportive organisations, public administration) and the interaction routines established between them. Moreover, institutions largely influence both actors and their interactions. In line with North (1990) and Edquist (1997), institutions are here understood as the ‘rules of the game’ (e.g., laws, norms, culture, routines) that influence actor’s behaviour, for example by reducing uncertainty. Actors, their interactions and institutions altogether form ‘systems’ which as will be explained, tend to be path-dependent, change slowly and be highly localised in space (e.g., Cooke, 2001).

2.1.1 Production-innovation system

This system is composed by a set of actors, economic activities and competences developed overtime in a specific place, backed by specific institutional environments (Boschma, 2004). It is path dependent as human action (e.g., entrepreneurs, academic researchers), organised structures (e.g., firms and its routines, industries, universities and their curricula) and surrounding environments (e.g., established social relations, industrial policies and supportive industrial organisations) interact and co-evolve with each other (Maskell and Malmberg, 2007). van Winden et al. (2007) approached this system as resulting from the interaction of a city’s economic and knowledge-base: its features set the degrees of freedom for the economic progress of cities and regions in the knowledge economy, namely by continuously producing (positive or negative) external economies of scale and scope.

In evolutionary thinking to economic geography (Boschma and Frenken, 2006), three combined sets of mechanisms underlie the place-based reproduction of this system, namely:

- 1 labour mobility, i.e., through the knowledge and skills embodied in employees that change jobs in a region within the same or related industries (Boschma et al., 2009)
- 2 knowledge spill-overs, i.e., through localised social networks, interaction and (planned and unplanned) exchange between firms and other organisations, backed by physical and relational proximity (Gertler, 2003; Maskell and Malmberg, 1999)
- 3 spin-offs, e.g., when new firms inherited the competences, knowledge and routines of rooted ‘parent’ organisations, like older established firms and entrepreneurs (e.g., Wenting, 2008).

A consequence from the previous is that this system is not likely to change dramatically, at least in the short run, but to evolve towards related activities that make use of former regionally accumulated competences and institutional settings (Boschma, 2004).

Despite its path dependent features, there is room for human and organisational agency to make new activities emerge, changing, redirecting or diversifying the course of events, and eventually leading to new self-reinforcing paths (Martin, 2010). On the one hand, change in a place’s production-innovation system can happen from within, e.g., when a firm or an industry responds to new market needs through new entrepreneurial

efforts or, e.g., when influential and motivated individuals (entrepreneurs, academics) mobilise other actors and shape the development of policy networks to tackle emergent opportunities (e.g., the development of a new knowledge location). On the other hand, change can also be set in motion by events external to the system, or from the development of linkages with other systems in other regions (Bathelt et al., 2004; Vale and Carvalho, 2013). Typical examples include the inflow of talent (Saxenian, 2007) and or foreign direct investment from other regions (Vale, 2004; Pike et al., 2006).

It can be expected that the structural features – and the dynamics – of this system will influence the emergence and development of new knowledge locations. The system's path dependence influences and simultaneously limits the degrees of freedom for the emergence and development of new activities in a certain urban region, and thus the type of activities that may agglomerate and prosper in a certain knowledge location. But at the same time, organisations and individuals within the system may have a particular interest in new institutional arrangements (e.g., the emergence of new regional economic activity and innovation niche) and may shape the direction of events by e.g., proposing, initiating or endorsing the creation of a new knowledge location.

These individuals and organisations may do so by leveraging resources and exercising different types of power (French and Raven, 1959). They can, e.g., mobilise new competences and privileged information about the type of location that should be developed to cope with emerging economic and innovation challenges; act as charismatic supporters and attract other parties to the project or, on the contrary; exert resistance to the project. For example, industrial lobbies and local leader firms may exert power to defend their vested interests; or a specific research group within a university may steer the development of a new location to commercialise an emergent set of new technologies. Some actors may even play dual roles in-and-out of the system's structures (Sotarauta, 2009). For example, tenured professors may act within the university's rigid structures and simultaneously support the emergence of new commercialisation platforms of academic results and knowledge competences, e.g., through endorsing and becoming involved in the development of knowledge locations.

2.1.2 Policy-planning system

However, the emergence and design of knowledge locations is often not solely dependent on a place's economic and innovation dynamics, or on actors such as firms, knowledge institutes and industrial lobbies. The emergence and development of knowledge locations is highly embedded in planning processes and political discourse, bargaining and influence (Clarysse et al., 2005; Wong and Bunnell, 2006). The development of knowledge locations is usually under the responsibility of sub-national government tiers, namely local governments, articulated (or not) with regional and national authorities. In fact, actors and organisations within policy and local planning systems tend to have significant resources for the development of knowledge locations, such as land, finance, political legitimacy and legal power.

Like in production and innovation systems, also the policy and local planning system can be conceptualised as formed by a set of elements, structures and institutional environments, the latter being less prone to change in the short run. It encompasses:

- 1 policymakers and related agents (e.g., mayor, elected politicians, directors, consultants), as well as other players like real-estate developers and citizen groups

- 2 the formal political and administrative *skeleton* (Carlsson, 2000) – e.g., local and regional parliaments, municipal departments, development agencies
- 3 specific formal and informal institutions.

Examples of the latter are local administrative procedures and planning regulations; procurement methods; municipal laws, but also informal networks with other organisations within and outside the public administration system (e.g., other municipalities, regional and national governments, developers); cooperation routines between different municipal departments; openness to ideas from outside the formal administrative system and previous institutionalised capacities to organise large development projects (van den Berg et al., 1997; Carvalho et al., 2016).

Likewise, this system is also path dependent to the extent that past structures and history determines its present features. Structural features change slowly overtime and influence actors' behaviour, yet co-evolving with it in the medium and long run. However, individual actors and organisations have some freedom to act and foster institutional ruptures and change. Urban and regional studies provide several illustrations of entrepreneurial mayors and visionary planning directors who provoked tension in the system, established new networks, changed procedures and paved ground to new institutional arrangements (Carvalho et al., 2016). Moreover, besides elected representatives, other actors in the system are also in the position to act in-and-out system simultaneously. For example, regional development officers are part of administrative systems but may simultaneously mobilise networks and informal contacts, seducing policy makers towards certain policy decisions and new innovative projects (Sotarauta, 2009; Carvalho et al., 2012).

A new knowledge location may thus emerge from the action of agents and organisations within the policy-planning system. It can happen in isolation, e.g., when municipalities independently develop land and infrastructure to be leased to new activities, contracting it out to other parties and managing it centrally. However, and as the objectives behind knowledge locations diversify, the resources for their development are increasingly not solely confined to actors within planning systems, reason why other actors from other systems (e.g., production-innovation players) become involved to bring a new knowledge location into existence, nudging actors from different systems to entail in joint policy efforts and collective action (Phan et al., 2005).

Summing up, knowledge locations emerge and develop in concrete socio-economic landscapes, with history and texture. On the one hand, a region's production and innovation system influence its emergence and profile – e.g., through the alignment of agents, institutions and their vested interests; through the action of 'out-of-the system' agents; or combinations of both. On the other hand, also the political and planning system has an influence, namely through the specific dynamics of local policy making processes, cooperation routines and planning traditions. There might be different gradients of influence of the two systems (depending on the involved actor's power and influence), but they will – implicitly or explicitly – interact to make a knowledge location emerge, influencing the location's design, vision and features.

2.2 *Knowledge locations: governance arenas, dynamics and change*

The interaction between the aforementioned actors can be conceptualised as unfolding in concrete governance arenas, i.e., networks of interdependent actors involved in a common venture. In a context of rising societal challenges, policy and planning systems often lack the resources (information, skills, finance) to fully organise large development projects alone (Carvalho et al., 2016). Over the last decades, this gave rise to several types of public-private partnerships, but also to multifaceted power relations and struggles between various actors – like government authorities, universities, business associations, developers and local communities – involved in the development of knowledge locations (van Winden et al., 2013).

Governance arenas for knowledge locations may come to life sparked by different sorts of catalysts (e.g., perceptions of economic decline, growth pressures, urban regeneration plans, funding frameworks, external opportunities, etc.), which may trigger the action of different types of actors in a city. Since these catalysts often manifest themselves in several different possible combinations, also the actors involved in the planning of knowledge locations are also diverse, representing different interests and holding different knowledge and resources. Thus, the associated partnerships and governance processes represent exemplary policy arenas for joint action, where actors struggle to align interests into a single compatible denominator, allowing for formal and informal coordination.

The level of involvement and the ‘object’ of cooperation may however vary substantially over time. In two extreme situations, there might be situations of effective joint cooperation and resource sharing – e.g., in the case of having strongly committed partners from public administration, industry and university – or, instead, simply one-sided ‘self-referential organisational decisions’ (Teisman and Klijn, 2002). Whether one or other side of the gradient prevails is likely to impact the physical and organisational profile of the new knowledge location (e.g., the location’s specialisation; the services rendered and management of the location; its spatial integration in the urban and regional fabric).

Some examples illustrate frequent tensions emerging in governance arenas for the development of knowledge locations (van Winden, 2011). For example, while the central interest of private developers might be to maximise the rents from new tenant firms, municipal governments may be interested in assuring a certain functional mix and diversity in the area, at the expense of office space; while universities might prefer to establish technology transfer centres close to their campuses, city administrations might want to ensure some decentralising of functions to the inner city; while some policy makers might want to develop a broad and more ‘open’ entry criteria in the knowledge location, some industrialists and knowledge institutes might claim for a more specialised location to guarantee cognitive proximity between tenants and better possibilities of interaction; while mayors and cultural elites might prefer to embed the new location in trendy streetscapes and landscape architecture, the local community might be interested in avoiding gentrification, social polarisation and find suitable jobs. Even within the municipal administration tensions might arise, e.g., between the economic and the Planning department, for alternative land uses and infrastructure development.

Therefore, the interests of the actors with the resources needed to effectively plan and develop the knowledge location will hardly be really convergent, even if they may look like at the first glance. Different actors, namely public and private, have fundamental

different interests, and nothing guarantee that an effective partnership will emerge, and that it will be established once-and-for-all. It is true that some different interests might become compatible and mutually adjustable after a number of negotiation rounds, but, in this case, the evolution of these arenas should better be seen as a series of punctuated equilibriums where actors exert their power over distinct negotiation ‘rounds’, rather than fixed and once-and-for-all governance schemes (Teisman and Klijn, 2008).

Yet, new changes in context and the emergence of new catalysts might require new governance arrangements (e.g., the opportunity to access to a new subsidy, entrance or exit of an actor, changes in the political agenda). Moreover, the very own evolution of the location over time might require the change of involved players in its development, or the emergence of new decisions out of learning and trial-error processes (Schwerin and Werker, 2003), or the influence gained by the location and its managers in regulatory frameworks and the very own spatial-economic context (e.g., innovation policy; local planning decisions). Hence, for the purpose of analysing the governance arenas involved in the development of knowledge locations, one should account for the complexity and dynamics involved in the process, which are beyond a linear sequence of activities and decisions (Kelly and Palumbo, 1992) but likely to change over time. Thus, in line with Teisman and Klijn (2008), we look at governance processes and their arenas as “timelines of interrelated actions developed by a variety of action systems (managers and organizations) leading to complex and dynamic changes in landscape, content and action” (p.295).

All in all, it can be expected that the interests and exerted power of the involved actors will strongly influence the location’s profile and features (e.g., knowledge specialisation; integration in the urban fabric). Yet, this design is not static and once-and-for-all. New external developments and catalysts may imply further changes. Moreover, the vision and design may evolve as the location gains traction (or not), becoming part of the socio-economic landscape and thus influencing further governance and development rounds.

3 Research setting and methods

3.1 Case studies

In the following sections, the previous framework and propositions are explored and illustrated with the support of two case studies of processes of emergence and change in two European knowledge locations: Arabianranta (Helsinki, Finland) and Biocant (Cantanhede, Portugal). Both locations are considered to be rather successful in nurturing new economic activities and attracting talent, and their visions have evolved considerably since the location’s inception. They also show marked differences in terms of socio-spatial and institutional contexts, economic specialisations and integration in the urban fabric. Altogether, these features allow demonstrating the generalisability potential of the framework to study emergence and change across different types of knowledge locations.

Arabianranta (Helsinki, Finland) locates in the birthplace of Arabia, once one of the biggest porcelain companies in Europe. After the plant was restructured in the 1980s, the Helsinki University of Art and Design (TaiK) relocated into their premises, igniting a large urban redevelopment project in a deprived, former industrial neighbourhood.

Arabianranta's district was then planned to host a diversified mix of functions around the broad theme of *art and design*, including new office premises, education, consumption and multiple types of housing. In 1995 a letter of intention was signed by the City of Helsinki and TaiK in order to create Art and Design City Helsinki, Ltd. (ADC) – a public-private company responsible for coordinating the developments in Arabianranta and manage the participation of landowners, private parties, universities and the area's inhabitants. Various higher education institutions followed TaiK to Arabianranta, adding up to 12,000 students and 5,000 residents to the area in 2011. Owing to a diverse social and functional mix, Arabianranta pioneered the implementation of citizen-driven test-beds in Europe, also dubbed as 'living labs' (e.g., Eriksson et al., 2005). At late 2011, an approximate number of 150 'knowledge-intensive' and 'creative' companies located in Arabianranta's multiple business premises, as well as several other start-ups distributed among incubators and shared office space. Arabianranta has been widely presented one of the best examples of integrated, 'creative-led' urban redevelopment around a concrete knowledge theme: art and design (Ilmonen and Kunzmann, 2007).

Biocant (Cantanhede, Portugal) is a science and technology park developed in a greenfield location near the city of Coimbra. Coimbra is well known by its university (Casaleiro, 2011), but its economic base is relatively fragile and has been on the decline. It was only during the last decade that the University of Coimbra started to commercialise applied research, namely in the fields of life sciences. In the early 2000s, Biocant was created as a partnership between Municipality of Cantanhede and the Centre of Neurosciences and Cell Biology (CNC, University of Coimbra) as a knowledge location fully specialised in biotechnology. Beyond office and state-of-the-art laboratorial space, Biocant provides distinctive services for its tenants, such as early-stage validation of biotechnology projects, informal brokerage and mentoring. Biocant has strictly maintained its biotechnology focus over the years. In late 2012, Biocant hosted about 30 dedicated biotechnology companies and eight biotechnology research organisations, with a focus on applied research and technology transfer. Some entrepreneurs and lab directors are graduates from Harvard University and the MIT and many companies and entrepreneurs from Porto and Lisbon relocated to Biocant during the early 2010s.

3.2 *Methods*

Beyond the aforementioned snapshots, the emergence and development of Arabianranta and Biocant was explored with the support of in-depth interviews with the locations' proponents and key stakeholders in Helsinki (26 interviews) and Coimbra-Cantanhede (20 interviews). Most of the interviews were carried out during 2009–2011, under the setting of two international research projects focused on the development of knowledge locations in cities. Interviewees included representatives from firms, research organisations, management staff of the location, government representatives, real estate developers and other key informants. Moreover, in order to increase reliability and reduce recall biases, other secondary sources were also used, including reports and documents about the location's vision, strategies and results, tenant's surveys, press releases, contextual reports on the location and the region, personal communications, other literatures, etc.

To make sense of development dynamics, a temporal bracketing strategy was used (Langley, 1999), dividing the 'lifetime' of each knowledge location in successive periods. In order to identify such periods we used of a 'rounds-model' framework (Teisman,

2000), according to which a new period (or round) begins and ends each time a new ‘problem-solution combination’ (reflected in a vision or ambition) and/or the involved actors change. Such framework organises the information in order to have continuity in the location’s vision and profile within each period but discontinuity at their frontiers. By doing so, it allows for inter-temporal comparisons at the level of the location while considering changes in context, the occurrence of key events and emerging trends. This strategy proved well fit for identifying and understanding the (potentially nonlinear) development processes of knowledge locations, in which actions undertaken in one period lead to changes in context, affecting action in the next periods.

Table 1 Arabianranta: governance rounds, chronology of events and context

<i>Round 1: ‘living and leisure’</i>	
<i>Actors:</i> City of Helsinki, private land owners and developers	
Problem-solution combination: conventional public-private land-urban development plan	
1986	TaiK (Helsinki School of Art and Design) relocates to the vacant factory of Arabia, in the deprived Arabianranta district
1987 to 1990	Talks between TaiK and the City of Helsinki on whether TaiK’s relocation would be permanent or temporary City’s planning department idea for the area consisted in developing a urban park and some real estate, benefiting from the waterfront location
<i>Round 2: ‘art and design city’</i>	
<i>Actors:</i> City of Helsinki, TaiK; Private owners and developers; industrialists	
Problem-solution combination: public-private partnership for a large urban redevelopment focused on art and design	
1991 to 1992	Soviet collapse and deep economic downturn in Finland Urban park idea abandoned for the development of a (job-creating) multi-function urban redevelopment, focused on ‘art and design’ Detailed master plan and soil remediation starts
1994 to 1996	Art and Design City Helsinki Ltd. (ADC) founded by the City of Helsinki, TaiK and private land owners to coordinate the area’s development. Relocation to Arabianranta of the Helsinki Pop and Jazz conservatory and the Faculty of Culture and Services of the Helsinki Polytechnic
1997	Helsinki City Council decides to make Arabianranta a pilot for local ICT services; launch the first European fibre optic network in the area.
1999 to 2000	Start of new building construction and progressive location and relocation of new residents and businesses
2001	Launch of the digital portal ‘Helsinki Virtual Village’ in Arabianranta; consolidation of the local area fibre network and internet service packages. Development of intra and inter building ICT communication platforms.
<i>Round 3: ‘Social Innovation Valley’</i>	
<i>Actors:</i> ADC, City of Helsinki, TaiK, industrialists, residents association	
Problem-solution combination: public-private partnership for a large urban redevelopment focused on art and design + hub of ‘social innovation’	
2001	‘Dot.com’ IT bubble in the US; emerging policy concerns on the threats of ICT overspecialisation in Helsinki

Source: Fieldwork

Table 1 Arabianranta: governance rounds, chronology of events and context (continued)

<i>Round 3: 'Social Innovation Valley'</i>	
2003 to 2004	Arabianranta hosts Europe's first 'living labs' (user-driven innovation method brought from the MIT by a TaiK's professor), with Nokia, TaiK and residents. Relocation of the Finland-Swedish University of Applied Sciences and the Prakticum vocational institute.
2005	New development plan for Helsinki region envisages a 'world class place for innovation, ICT and combinations of art, design and technology in businesses'. During the Finnish EU presidency, the EU network of living labs is founded. National law incentivises the merger of higher education institutions. The City of Helsinki and a number of large companies create Forum Virium – association promoting living lab experiments in the Helsinki region.
2006 to 2007	More than half of the new housing, university and office space has been developed and progressively taken. Tekes (national innovation agency) recognises design as an important innovation field (after a previous focus on 'hard' technology). Hundreds of living lab projects has been already run in Arabianranta, by many companies (in domains such as health, mobility, etc.). The area is firstly dubbed by external commentators as a 'Social Silicon Valley' (end 2007: Arabianranta hosts around 5,000 residents; 5,000 workers; more than 1,300 students; national and international companies).
<i>Round 4: post-TaiK (...)</i>	
<i>Actors:</i> ADC; Still open	
Problem-solution combination: still open	
2008	Creation of Aalto University: merger of the Helsinki Schools of Business, Technology and Art and Design.
2009	City of Helsinki applies to be entitled World Design City in 2012, influenced by the past decade's developments in Arabianranta.
2010	Arabus – the incubator of TaiK, leaves Arabianranta to re-locate in Ruohonlahti district (Aalto University start-up centre and 'cable factory' – hub for creative industries)
2011	TaiK is planned to relocate in the coming years to new premises in Otaniemi, campus of the School of Engineering (proximity of large firms).

Source: Fieldwork

Consequently, the knowledge location was put central and the research traced back changes in the involved actors, visions and designs since the first idea until late 2011. The analysis placed such changes in the context of key associated events (either external to the system or resulting from actor's self-organisation) and the progressive structuration of new spatial-economic contexts underlying the location. Table 1 and Table 2 synthesise the results of the analysis, presenting a timeline for each knowledge location, divided in a number of decision making rounds and vision configurations.

Table 2 Biocant: governance rounds, chronology of events and context

<i>Round 1: general business and technology park</i>	
<i>Actors:</i> City of Cantanhede; Consultants, Business Parks Association (ABAP)	
Problem-solution combination: municipal-driven, general business-technology park	
1999	The strategic plan for Cantanhede suggested the development of a (generalist) business-technology park to support economic diversification.
2000 to 2001	ABAP (association for the development of business parks in the region) is formed by Cantanhede and other neighbouring municipalities.
2002	The Mayor of Cantanhede applies for EU funding with the regional authority to develop the business-technology park (pure condominium-style). The tender is refused due to the lack of focus and research/university partners.
2003	The Mayor of Cantanhede starts the land development process with own resources, yet in a slow pace. The ABAP partnership loses momentum.
<i>Round 2: Biocant – biotechnology park</i>	
<i>Actors:</i> City of Cantanhede; ABAP; Coimbra’s Centre of Neurosciences and Cell Biology (CNC)	
Problem-solution combination: research-driven biotechnology park, supported by the municipality	
2003 to 2004	The University of Coimbra’s Centre of Neurosciences and Cell Biology (CNC) successfully concluded a technology transfer project (XPROT) and shows interest in the development of new labs and infrastructure for research commercialisation. CNC’s vice-president nudges the Mayor of Cantanhede to re-orientate his idea towards a fully dedicated biotechnology park. The University of Coimbra uninterested in the development (‘ivory tower mindset’). A new tender for a dedicated biotechnology park (Biocant) is jointly submitted by Cantanhede and CNC for EU funding (now approved).
2005	The first building of Biocant is inaugurated, with R&D and technology transfer labs.
2006	Six technology transfer units/labs are staffed in Biocant (in partnership with the Universities of Coimbra and Aveiro) The second building of Biocant is inaugurated; the first biotechnology companies move in/start-up in Biocant (from national and international entrepreneurs). Biocant created 60 direct high-qualified jobs in the first year. Creation of Biocant Ventures, public-private venture capital company
<i>Round 3: Biocant – national biotechnology hub</i>	
<i>Actors:</i> City of Cantanhede; ABAP; Coimbra’s Centre of Neurosciences and Cell Biology (CNC)	
Problem-solution combination: research-driven biotechnology park, supported by the municipality, national hub	
2007	Biocant model inspires/influences the design of Portuguese regional innovation policy and funding schemes (2007–2013), highlighting the specificities and role of biotechnology. Biocant managers become founding members of the national health cluster initiative.
2008	Establishment of two new dedicated technology transfer labs in Biocant, run by former PhD graduates from MIT and Harvard University. University of Coimbra publicly supports and recognises Biocant.

Source: Fieldwork

Table 2 Biocant: governance rounds, chronology of events and context (continued)

<i>Round 3: Biocant – national biotechnology hub</i>	
<i>Actors:</i> City of Cantanhede; ABAP; Coimbra's Centre of Neurosciences and Cell Biology (CNC)	
Problem-solution combination: research-driven biotechnology park, supported by the municipality, national hub	
2009	The third building of Biocant starts to be built; firm's demand keeps buoyant. Biocant managers support the development of entrepreneurship networks and related initiatives in the region
2010	Other Portuguese biotechnology start-ups (from Lisbon and Porto) relocate operations and labs to Biocant. The Portuguese Association of Bio-industries relocates headquarters from Lisbon to Biocant
2011	The City of Coimbra launches a number of health-related cluster policies. The new CNC building (150 researchers) in underway in Biocant (relocation from dispersed university buildings in Coimbra) Biocant reports a 30% increase in private contract research nationally and internationally, despite the economic downturn
2012	Biocant hosts eight technology transfer labs and 28 permanent and affiliated biotechnology companies.

Source: Fieldwork

4 Emergence: actors and institutions

4.1 Arabianranta

The case of Arabianranta clearly illustrates the logic behind the previous conceptual framework. Helsinki has a long tradition in art and design, configuring a well-established production-innovation system. It hosts a dynamic labour pool of design-related jobs and a large number of elite designers and craftsmen. The city hosts indigenous design-driven multinational companies (in industries such as furniture, pottery, ceramics, decoration and fashion) as well as many small-scale design offices and free-lancers. Long before the first plans to develop Arabianranta, Helsinki was already an international reference in design and applied arts; internationally well-known designers such as Alvar Aalto or Kaj Franck inspired and directly trained many other Finnish designers, giving rise to a genealogy of design talent throughout the century (e.g., Design Forum Finland, 2004). Over time, the educational infrastructure in Helsinki closely co-evolved with the needs of the industry – TaiK became a highly renowned design school in Helsinki and beyond in domains such as applied art and design in ceramic and glass; spatial and furniture; fashion and clothing; textile art and design.

With no surprise, visions for Arabianranta as an 'art and design city' were directly influenced by actors from within this system and with a strong interest in art and design from a production and innovation perspective. First, land plots and former building premises in the area were still owned by industrialists in the art and design field, with interest in developing a new 'showroom' for their products while leveraging society's overall interest for art and design. Second, and related with the former was the role and influence of TaiK, who moved to the former premises of Arabia early in the mid-1980s;

TaiK was willing to strengthen their presence in the district, improving their surrounding physical and social environment while promoting design in society. The role of TaiK in the area (thousands of design students) and the vision of the School's charismatic Dean Yrjö Sotamaa convinced the City of Helsinki and its officials of the potential of an 'art and design' concept for the area's redevelopment (van Tuijl et al., 2013).

However, the policy and planning system of Helsinki was also pivotal in the emergence and feasibility of the whole concept. The idea to plan Arabianranta as a functional and socially mixed area was largely put forward by a proactive yet controversial planning director, who nudged his more conservative peers and the mayor to adopt such a concept back in the early 1990s. However, such a concept could only emerge – and be sustained – under the concrete institutional framework of Helsinki's planning system. First, Helsinki's planning power tradition and public land ownership allowed to better controlling for the mix of functions and overall concept. Second, the tradition of public-private cooperation for large development projects facilitated the involvement of real estate developers since the beginning of the area's master planning, thus avoiding redundancies and improving the quality of the concept and implementation speed. Third, the specific local regulations for subsidised and price controlled housing (so-called HITAS regime) played a key role, avoiding market selection towards exclusively high-end real estate, facilitating the social and functional mix in the area.

4.2 *Biocant*

Contrarily to Arabianranta, a biotechnology-related production-innovation system in the Coimbra region was practically inexistent at the time of Biocant's emergence: the region had no firms or relevant tradition in commercial exploitation of bio-life sciences. Yet, the University's R&D centres and hospitals had relevant research skills and a stock of accumulated knowledge in the field. The vision and idea for Biocant directly owes to Professor Carlos Faro, Vice-Director of Centre of Neurosciences and Cell Biology, University of Coimbra (CNC), whom in 2004 was in search of a proper place (read: outside the university bureaucracy) to commercialise research and support new biotechnology ventures. In 2004, Prof. Faro convinced the Mayor of Cantanhede of the economic potential to develop a biotechnology science park instead of a more generalist business location, as previously envisioned by the municipality. Having a committed scientific partner such as CNC was decisive in the municipality's efforts to successfully tender for European funding to build the park's premises.

Professor Faro was backed by the board of CNC but assumed a position 'in-and-out' of the system, since, by the time; the University's Dean was uninterested in the project. However, the previous experience of the University in technology transfer (e.g., in IT and engineering fields) indirectly influenced Biocant's design. The management of Biocant's applied research labs was inspired by other applied IT labs from the University's incubator (managed by an executive full time director plus a scientific director affiliated with the university). This model assured the quality and visibility of the centres and helped to give the park an initial boost.

From the side of the policy-planning system, the Municipality of Cantanhede had been developing for some years an 'experimentation' drive, largely due to an entrepreneurial, recognisably risk-taking mayor. Moreover, the municipality's smaller size vis-à-vis Coimbra and the availability of city-owned land speeded up the development process. Despite being under the very same National planning regulations,

developing Biocant in the Municipality of Coimbra would be potentially slowed down by the rigid and bureaucratic functioning of a larger city administration, with limited experience in economic development initiatives and with too close bonds with the University of Coimbra. At best, the development would take much more time to emerge. However, despite the strong support from the municipality, the technical design and vision for the location was very much in the hands of the technical directors from CNC, who decisively influenced the location's vision.

5 Dynamics and change: multiple rounds of decision making

5.1 Arabianranta

Arabianranta is often referred to as an exemplary knowledge location by sticking to a consistent 'art and design' concept over time. This is partly true, but not the whole story. Three different periods can be identified in the timeline of Arabianranta, over which the visions and concept for the location evolved (see Table 1). By the late 1980s, the first concept for Arabianranta – championed by landowners and by a conservative branch of Helsinki's planning department – was to develop a large urban park, surrounded by high-end housing. Only by the turn of the decade such a 'living and leisure' vision changed towards the development of multi-functional 'art and design city'. To this contributed the Soviet collapse and the economic downturn in Finland (and the need to create jobs), but also the increasing influence of TaiK and its Dean in the area and in the City's policy making spheres, together with the innovative ideas of the City's planning director. The 'art and design city' was planned through a public-private partnership between the City, TaiK, industrialists and landowners, mediated by ADC. With these actors on-board, the progressive infrastructure development and early relocation of firms, educational institutes and residents unfolded during the mid-late 1990s (Table 1).

Despite the stability of the holistic 'art and design' concept, a related yet slightly distinct vision for Arabianranta emerged and gained ground from the early 2000s onwards, namely Arabianranta as a 'social innovation valley'. This was recognised by its proponents as 'the new big thing' to do in Arabianranta: nurturing user-driven innovation and test bedding industrial and IT solutions, facilitated by the district's advanced IT infrastructure, mixed functions and diverse types of consumers. This vision's evolution did not come out of the blue: it was largely influenced by the first successful user-driven 'living-lab' experiments in the district, a method pioneered by TaiK (imported from the MIT) and Nokia. Thus, besides coordinating the area's infrastructural development, ADC gained a new influential role in Arabianranta's vision, namely as a 'mediator' of such experiments due to its role linking up with the area's users (companies, residents, etc.).

Hence, during the 2000s, many living lab experiments took place in Arabianranta. New related partnerships were created in Helsinki to scale-up living lab experiments in other urban areas; at the same time, the role of design and user-driven innovation became increasingly recognised by the Finnish Innovation Policy and exported to other places (e.g., through a newly created European network of living labs). Arabianranta gained strong national and international recognition during the decade as an 'art and design' and 'social innovation' hub, hosting an increasing number of companies, students and residents. The deployment of user-driven innovations and citizen involvement methods,

as well as the whole partnership model around a common theme is currently being deployed in the redevelopment of former port areas in Helsinki. However, by the end of 2008, the decision of TaiK to leave the area (due to a merger of universities in Helsinki) left a void in the vision for the area, opening up a new stage whose new actors and problem-solution combinations were still unknown in late 2011 (see Table 1).

5.2 *Biocant*

The evolution of Biocant's governance arena and vision over time is also illustrative of the previous theoretical argument. The location's vision and profile evolved from a generalist business park towards a biotechnology hub of national significance (Table 2). Three different rounds and problem-solution combinations could be identified. The first round started in 1999 when a planning consultant convinced the Mayor of Cantanhede of the advantages of a condominium-based, 'high-tech' business park, with an eye to lure new firms to the municipality. Seduced by the idea, the Mayor of Cantanhede and other neighbouring municipalities founded a new association to manage the park (ABAP), envisioning the development of a larger network of business parks in the region. In 2002 the mayor and ABAP applied for European funding to build the park in Cantanhede. Yet, the tender was rejected due to the lack of focus and of scientific partners. The land development process started anyway in 2003, but in a much slower pace.

A new round started in 2003–2004, with the entry of a new key player in the governance arena. CNC was looking at that time for a place to settle their technology transfer labs and managed to convince the Mayor of Cantanhede to give the planned location a fully-fledged biotechnology focus – 'Biocant-biotechnology park'. Now with a clear focus and with CNC on-board, a new funding application was approved in 2004 and the involvement of ABAP lost momentum. During 2005–2006, the first two buildings were developed, hosting six technology transfer centres from the onset; those were followed over the period by a dozen of biotech start-ups (from national and international entrepreneurs) and a specialised venture capital company.

By the end of 2006, Biocant was widely recognised as the first truly specialised knowledge location in Portugal, with a focus on biotechnology. The promising success at early stages – rising concentration and commercialisation of bio-services, increasing number of R&D centres and start-ups – raised the ambitions of the park towards a 'national biotechnology hub'. This new 'problem-solution' combination was still on going in early 2012; moreover, it could only emerge and gain leeway as Biocant itself provoked changes in the spatial-economic context of the region and at the national level. Biocant's model partly influenced the design of the Portuguese regional innovation policy 2007–2013; moreover, its managers became founding members of the national health cluster initiative, calling further attention to the role of biosciences' commercialisation in society. Firms' demand to settle in Biocant kept growing, and new R&D centres were established, headed by star scientists. Biocant's managers and firms' staff got increasingly involved supporting (e.g., mentoring, investing) new bio-entrepreneurship initiatives in the region. In 2011, the City of Coimbra launched a health-related set of initiatives, and a new building to host the whole CNC (150 researchers) started to be developed in Biocant, now with the full support of the university (see Table 2).

6 Discussion

The two cases studies provided empirical support and helped illustrating the tenets of the conceptual framework. As posited in Section 2, this framework brings contextual and time dimensions to the study of knowledge locations in cities, thus contributing to better understand their emergence and development dynamics – which are often underplayed in context-free and snapshot-based analyses. A number of reflections and discussion points can be further drawn.

First, the cases illustrate that even when it was not evident at the first glance – i.e., when one or other system seemed dominant –, actors from both production-innovation and policy-planning systems influenced the emergence and negotiated the design of the knowledge location. Both for Arabianranta and Biocant, the leading actors interested in the development of the location needed multiple resources (knowledge, funding, legitimacy) partly ‘owned’ by others. However, the cases also illustrate different magnitudes of influence. In Arabianranta, the actors from the two systems (e.g., design industrialists, TaiK, local government) exerted their power in a relatively balanced way vis-à-vis one another, which resulted in a knowledge location with a strong production-innovation drive, but also pursuing many urban integration and local community-based objectives. In the cases Biocant, the influence of actors from the production-innovation system was much more prevailing, thus leading to a vision and strategy that clearly privileged production-innovation outcome (i.e., biotechnology commercialisation in a greenfield location).

Second, despite the role played by the previously mentioned actors, the emergent designs of Arabianranta and Biocant largely owe to the ‘texture’ of the regional institutional settings grounding the functioning of both systems (e.g., planning regulations, cooperative culture and design tradition of Helsinki; organisation and routines of applied R&D labs in Coimbra). This illustrates that the notion of system (with actors and institutions, or ‘players’ and ‘rules of the game’) provides for a more complete explanation of emergence and design of a knowledge location. The strategies and visions of their proponents appear to be actively shaped by the institutions that together form the concrete spatial-economic context.

Third, Arabianranta and Biocant illustrate the nonlinear development pattern of knowledge locations, co-evolving along multiple rounds of decision making. They show that changes in a location’s design do not necessarily result from bad planning, but from a natural evolution process as internal and external-to-the-location change and unexpected events unfold. The latter can both result from macro-related changes (e.g., severe economic downturns, like in Helsinki), or from actor’s own self-organisation, such as entries or exits from a location’s governance arena (e.g., CNC in Biocant). Moreover, actors’ behaviour shows to be largely adaptive, relying on the emergence of new ideas by current actors (e.g., development of living labs in Arabianranta) and trial-and-error and learning (e.g., the re-composition of the partnership following a lost tender, as in Biocant).

Finally, from a certain moment onwards, knowledge locations start to exhibit relevant path dependencies, as decisions taken in one moment of time will influence action in subsequent moments. Hence the reason why the two studied locations show signs of co-evolution between the development of the location, its spatial-economic context and the governance arena that shapes future visions and decisions (e.g., the emergence of bio-supportive institutions in Coimbra). A result from the previous is that after the

definition of a core concept for a knowledge location it does not tend to change radically, but to progressively evolve, realign visions and adapt (e.g., like in Arabiananta's evolution from 'art and design' visions towards including 'social innovation' ambitions).

7 Conclusions and policy implications

This paper proposed a conceptual framework to understand emergence and change in knowledge locations. More concretely, it argues that the study and practice of this popular policy tool can benefit from explicitly considering the production-innovation and policy-planning systems of their cities. Moreover, it has been shown that a location's development can be seen as a result of a co-evolutionary process between the urban context, change in governance arenas and the location's development itself. As knowledge locations increasingly pursue more demanding and complex objectives for knowledge-based urban development – e.g., from hosting high-tech companies to steering innovation synergies and regenerating urban areas – these analytical considerations are deemed increasingly relevant.

These analytical dimensions contribute to explain why copying concepts and 'best practice' designs of knowledge locations from elsewhere proved so difficult and unrealistic. In fact, even if the types of involved actors and proponents are increasingly similar everywhere (e.g., firms, knowledge institutes, government, etc.), their influence and power in governance arenas is likely to be very different across places, let alone the coupling of their visions with the distinct features of a region's production-innovation institutions and planning routines.

However, this also means that a challenge for policymakers is to avoid the risk of developing too much demand-following designs, which ultimately may lead to the reproduction of old institutions, rent appropriation by powerful players and limited regional economic change. From a policy perspective, this calls for a balance between designing locations that fit the character of the regional context and, at the same time, have the potential to create change in urban and regional economies (e.g., by igniting new complementary activities that make use of existing regional assets and institutions). Moreover, and considering the long time spans and frequent changes in governance arenas over time, proponents of knowledge locations will increasingly face the challenge of defining a promising vision and recognisable design while keeping knowledge locations flexible enough to cope with change.

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