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Spatial proximity and how to shape it: An empirical case study of selected German technology parks

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Elena-F. Schlich

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SPATIAL PROXIMITY AND HOW TO SHAPE IT: AN EMPIRICAL CASE STUDY OF SELECTED GERMAN TECHNOLOGY PARKS

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Abstract
The three interrelated factors of knowledge, learning and innovation are regarded as the key components of the knowledge economy (OECD 1996). In the past decades, attempts have been made to describe the systematic impact and correlation of these three factors by means of various concepts in connection with innovation theory. The spatial proximity of the respective bearers of knowledge in relation to each other was initially identified as an important aspect of the innovation process. Yet spatial proximity alone is not enough. Its innovation-promoting effects can only be realised in combination with other forms of proximity and physical spatial design features. Through this understanding of the underlying innovation theory, it was hoped that it would be possible to influence the innovation process, a possibility that is of particular importance for economic policy in connection with the construction of local knowledge infrastructures. Technology parks (TPs) bear witness to how insights into innovation theory have evolved. Hence, this article briefly outlines the development of the TP concept and examines the innovation-promoting effects it generates through the specific way in which it shapes spatial proximity. As illustrated by three case studies, the TP concept is adaptable to the innovation-promoting needs of organisations based on site. However, the analyses show that not all the measures and instruments actually benefit on-site knowledge networking as an innovation-promoting activity.

Keywords
Innovation process – knowledge – spatial proximity – knowledge transfer – technology parks

1 Spatial proximity as a driver of innovation

Before examining the current state of knowledge regarding innovation theory, it is useful to look at the history of its origins. There are two concepts for explaining innovation processes that stand out in the scientific debate. One of the first concepts to emerge was the linear innovation model, which was soon criticised for its inadequate alignment with the structural requirements of knowledge networking (Kline/Rosenberg 1986: 285). What drew the most criticism was its assumption that the process was linear. In response to this criticism, the subsequent chain-linked model was devised, which interprets the innovation process in a much more multifaceted manner, particularly by including feedback structures (cf. Kline/Rosenberg 1986: 285 et seq.). Although each of the two concepts addresses the process of knowledge production and its interorganisational transfer according to a different system, both approaches combine interorganisational knowledge transfer with the aspect of the physical spatial proximity between the respective bearers of knowledge.

The recognition that physical spatial proximity is an important component of knowledge transfer, and thus of the innovation process, is not new. It was already pointed out by Hayek (1945) that thematic and problem-specific knowledge is shared between numerous stakeholders and first has to be consolidated through interaction aided by spatial proximity. Today, physical proximity has not lost any of its importance in this respect. On the contrary, it is becoming more and more indispensable in the face of increasing specialisation and accelerated product cycles (Maskell/Malmberg 1999). Even so, when it comes to innovation theory, there is consensus within the scientific community that although physical proximity can be important for a successful innovation process, it is not the only prerequisite. In this sense, it hinges on the 'right' combination of physical proximity and other forms of proximity, in other words cognitive, organisational (Rallet/Torre 1999) and social proximity between stakeholders (cf. Boschma 2005). Cognitive proximity can arise through the use of the same technologies and process flows, while organisational and social proximity can result from a shared past, for example through former colleagues (cf. Granovetter 1973; Ter Wal/Boschma 2009: 742).

As a basis for ensuring that spatial design principles promote networking by providing an effective combination of different forms of proximity, the urban agglomeration area is currently growing more important as a location for business and innovation in the transition towards a knowledge economy (cf. Siedentop 2008: 201; Brandt 2011: 165 et seq.). As discussed by Oldenburg (1989), among others, through his notion of *third places*, there are many factors that promote the innovation process and are generated by the social density of urban spaces. Aspects that are relevant for innovation and which promote networking manifest themselves through stronger, more evident synergy effects in urban spaces. At the same time, urban density enables regular face-to-face contact, which offers the opportunity to secure a knowledge advantage and build trust, which in turn can provide access to the implicit knowledge base of others (Kujath 2012: 219).

2 Technology parks as an instrument to promote innovation

Insights from innovation theory entered the sphere of economic policy in recent decades through the provision of local knowledge infrastructures. The objective was and is to foster spillover effects between science and business by creating spatial proximity, which in turn seeks to help knowledge-intensive companies generate, replicate and implement external knowledge bases. The technology park (TP) concept represents a special form of this knowledge infrastructure. Initially, it was based on the concept of linear knowledge transfer (section 1) and, as such, was criticised for its inadequate alignment with the structural requirements of knowledge networking (cf. Massey/Wield/Quintas 1992). In order to ensure a proper understanding of how the TP concept developed, it is important to start by laying the foundations for further analysis by providing a more detailed description of the traditional TP concept of the 1980s and 1990s. The TP concept can be defined by the following characteristics:

> Direct spatial proximity to scientific organisations (universities, non-university research institutions)

> Physical space reserved for knowledge-intensive businesses (research and development)

> Integrated technology centre (business incubator)

> Park management with the provision of certain services

> Closed, mono-functional area, usually in an out-of-town or suburban location (cf. Quiehl 1995; Kühn 2003)

The search for an effective combination of spatial proximity and other forms of proximity is exemplified by the development of knowledge economy locations and, in particular, the traditional technology park. These concepts illustrate the first systematic and scientifically grounded steps taken towards an understanding of the innovation process, and also reflect the continuous knowledge gains regarding the factors that influence this process. In the specialist literature, a discussion is already underway both on the transition in general and on specific measures to adapt the traditional technology park so as to promote knowledge networking between organisations based on site (cf. Annerstedt 2006).

In this context, Allen (2007) focuses in detail on the functional change of the TP concept through his elaboration of the generational concept. (see Table 1). According to this concept, the change in technology parks is interpreted as an ever growing expansion of both the range of services and support on offer and the physical design of the TPs themselves. Accordingly, the first generation of TPs was based on what was initially the 'simple' provision of land and space reserved for certain sectors. By focusing on a certain sector, cognitive proximity can be actively steered in order to maximise synergy effects (Boschma 2005). The first generation was expanded in the second generation through an expanded range of services provided by the park management. These services focused more on systematic, actively promoted net-

working between the on-site organisations through a wide variety of formats for thematic and problem-based networks and events. At the same time, this development reflects the philosophy of innovation underlying the TP concept – away from the 'science push' in the sense of a linear innovation process and towards the 'market pull' in the sense of the chain-linked model – since each stakeholder is equally considered a knowledge provider and a knowledge user (Annerstedt 2006: 286 et seq.; section 1). Within the third and most recent generation, Allen (2007) highlights another expansion, namely the design of the physical TP space in such a way as to promote communication and thus networking in a passive sense. The assumption here is that the integration of mixed-use structures within the park boosts the potential for encounters between stakeholders on site, which in turn can lead to collaboration on innovations (cf. van Winden 2010; Charles 2015). It is particularly this third generation that is currently reflected in the numerous development concepts for technology parks, and is associated with current developments regarding the reurbanisation of knowledge-intensive activities (cf. section 1).

Third TP generation	+	+	Additional measures to promote networking in the form of measures/ instruments for designing the physical TP space; the TP space as a passive instrument for networking
Second TP generation	+	Additional measures to promote networking in the form of thematic and problem-specific events formats, including TP management as an active 'networker'	
First TP generation	The provision of space, (sector-specific) selection of park members, first initiatives to promote networking between science and business		

Table 1: The generational concept of the technology park / source: the author after Allen 2007; EC 2013: 37 et seq.

It remains unclear to what extent these approaches contribute to an understanding of the innovation process. Any inferred assumptions regarding their effect on the innovation capabilities of on-site organisations are based on normative arguments, although the a priori expectation is that there are positive repercussions on interorganisational knowledge networking and thus on the innovation capabilities of organisations based on site. Given such implicit assumptions, this development has far-reaching implications, particularly for economic policy decisions regarding the conceptualisation and implementation of knowledge infrastructures such as TPs (cf. Hofmann 1995). On the other hand, the efficient conceptualisation and development of locations for the knowledge economy require an understanding of the effects of the measures undertaken to promote innovation, analysed in the specific context of the technology park. To date, however, such measures have not been identified and categorised in order to enable a systematic cause and effect analysis. Against this background, the present analysis will focus on technology parks of the 1980s and 1990s in Germany, and aims to consider two interrelated research gaps, which have not yet been adequately clarified. Firstly, there is a need to clarify the extent to which German technology parks are impacted by the measures undertaken to promote the innovation process. Secondly, the causal relationship between the measures and knowledge networking among on-site organisations also remains unclarified (van de Klundert/van Winden 2008: 6). Accordingly, the aim is to analyse the functional change of technology parks in the light of their spatial and functional design and the networking structures of organisations based on site, as well as the mutual influence of both aspects.

3 Methodology

The TP concept is analysed through a comparative case study as the overarching research design. On the basis of three case studies, the changes in how spatial proximity is designed, and the resulting effects on interorganisational knowledge networking between on-site organisations, are highlighted and compared. The three case studies in question – the Berlin Adlershof Technology Park (*Technologiepark Berlin Adlershof*), the Dortmund Technology Park (*TechnologiePark Dortmund, TPDO*) and the Heidelberg Technology Park (*Technologiepark Heidelberg, TPHD*) – were selected according to predetermined criteria in line with the characteristics defined in section 2.

In order to identify the measures associated with the spatial and functional change in the technology parks, seven to eight interviews with experts were carried out for each case study. The information obtained was deepened through studying the existing literature, expert reports and the author's own contributions to brochures and journals. For the purposes of this research project, experts are defined as people who are connected with the relevant case study and thus have privileged access to knowledge concerning the TP in question. For each case study, ten interviews were held with representatives of the enterprises on site. On the basis of these interviews, the networking-promoting effects of the design features of each TP were then analysed.

4 Technology parks of the 1980s and 1990s

4.1 Changing approaches to shaping spatial proximity and initial assumptions regarding their effects

The analysis of each case study and their subsequent comparison showed that, in terms of their developments, there were commonalities with the previously discussed generational model (section 2). All three case studies showed that, right from the start, the focus was on the active management of spatial proximity in particular. This can be seen as the basis for the exchange of knowledge, which in turn promotes innovation (section 1). At the same time, the organisational and social proximity of on-site organisations is promoted by generating spin-offs and start-ups of scientific organisations based on site. The various forms of proximity thus created were supplemented during the course of further developments, as reflected by the second generation of TPs (see section 2), through a wide range of networks aimed at promoting networking as well as event formats in all three cases studies (see Table 2).

	Case study-specific instruments / measures
Adlershof TP	Preservation of existing/historically evolved networks and inclusion of new stakeholders, events, networks (local, regional), conferences, seminars by WISTA GmbH (management) and on-site organisations (local, regional orientation); international TP partnerships
TPDO	Events, workshops, seminars, networks (local and regional) by TZDO GmbH (management) and other on-site organisations; transfer institution of the TU Dortmund University; minimal international orientation/partnerships
TPHD	Introduction of associated membership of the TPHD; events, networks (local, regional), conferences, seminars by TPHD GmbH (management) and scientific organisations, transfer institutions of the University of Heidelberg and non-university research institutions; expansion of international TP partnerships

Table 2: Overview of additional support initiatives for the three case studies as represented by the second generation / source: the author

It is particularly the measures and instruments of the second generation, and the associated active promotion of knowledge networking, that are confirmed by experts as having the potential to promote networking: '[...] *You still need someone to* ***make sure that networking is actually functioning****, because* ***it won't work on its own***' (*ExpertB2 2017*).

At the same time, the third generation is characterised by the establishment of physical, urban design features (section 2) in the sense that there is an integration of mixed-use functions. Here, however, there are striking differences in terms of the application of these design features in the three case studies. While at the TPDO and the TPHD, the additional design features were only available as mixed-use facilities during break times, TP Adlershof is characterised by a true urbanisation of the location. This manifests itself in an integration of the residential use function, an expanded infrastructure for the retail trade, food and service providers, and can be equated with the networking-promoting function of *third places* (section 1). The networking-promoting properties theoretically ascribed to the third generation (section 2) are substantiated by the experts in this case study in particular: '[...] *this* ***exchange of tacit knowledge****, this* ***meeting in third places****, in any places of communication, and* ***spatial proximity****, they're all extremely important here at this location* [...]' (*ExpertB5 2017*). In this sense, according to the experts interviewed, the assumed networking-promoting effects of the additional measures and instruments also apply to the three case studies.

4.2 Impact on the innovation process of the companies based on site

From the perspective of companies based on site, some of the design initiatives specific to each case study show a tendency to have opposing effects. First of all, it can be confirmed that active management of the respective forms of proximity in line with the first generation of TPs does promote networking within the TP, although in addition to fundamental cognitive proximity, it is particularly organisational proximity that contributes to long-term interorganisational networking (see Table 3).

However, there is much criticism of the measures and instruments used to actively manage proximity, in the sense of combining the respective forms of proximity in order to promote interorganisational knowledge networking on the ground (see Table 4).

	Adlershof TP	**TPDO**	**TPHD**
Organisational proximity (first generation)	'The trigger was **the proximity** to the Ferdinand Braun Institute, that's very clear, and it's what we needed **at the time, and we still need it now**.' (CompanyB8 2018)	'[...] what we've always done **all these years**, it was also, of course, ultimately about maintaining our **proximity to the University of Dortmund** here, all these years [...].' (CompanyD1 2017)	'Well, there are lots of people who in some way or other still **belong to** the company, or where services are rendered as part of a sort of **insiders' network**.' (CompanyH9 2017)

Table 3: Emphasis of the networking-promoting function of organisational proximity / source: the author

At the same time, the additional physical/spatial design measures have some surprising effects in terms of promoting networking among organisations based on site. While the addition of mixed-use functions in the form of conventional canteens for break-time purposes is perceived to promote networking within the TPDO and the TPHD, there is a tendency towards the opposite effect at the Adlershof TP in particular. This is attributed to the pronounced urbanisation of this particular location: *'Meeting places are always restaurants or cafés* [...]*, and the most important meeting place, namely* ***the company canteen****, which we used to have, has now gone. It's where the institutes and companies* ***all met****. You could also have a chat with people at lunchtime. That's not even possible anymore.* [...] *So now you go to the Rudower Chaussee, there's a Kaufland* [*supermarket*] *and a Chinese place there, and so that's where you go to eat. Just up here there's a Greek place; sometimes people go there to eat* [...] *but they're* ***small pubs*** *– you can't sit around* ***chatting*** *for ages because there are a hundred other people standing there waiting, and they all want to get something to eat too.* ***So it doesn't exist anymore, this type of encounter****'* (*CompanyB1 2018*). In this sense, therefore, the small-scale structures modelled on those in an urban setting and used in many mixed-use facilities tend to have a counterproductive rather than a beneficial effect for companies on site.

	Adlershof TP	**TPDO**	**TPHD**
Assessment of measures for actively managing forms of proximity (second generation)	'**I don't need a technology park operator**, who has another ten people sitting around doing nothing but **organising** how I can create synergies here. It **doesn't work**, it's just **not effective**. You can see that here really clearly: events are organised where companies are supposed to meet to create synergies.' (CompanyB1 2018)	'I don't get anything out of these **imposed networks**.' (CompanyD4 2017)	'I reckon [...] for a lot of things, including this **networking concept** – I'd say that on a small scale, **it just doesn't exist**, but of course it's what the technology parks always like to advertise, this idea [...]. But I don't think it has any impact at all in practice.' (CompanyH8 2017)

Table 4: Statements by company representatives on the effectiveness of the active promotion of networking / source: the author

5 Conclusions

A change in the TP concept was identified in the German TPs of the 1980s and 1990s. While at the start, the aim was active management of spatial proximity in combination with other forms of proximity, today the focus is more on the spatial design of the TP site to support interorganisational knowledge networking in a passive manner. The predominantly positive assumptions expressed in the specialist literature and by the experts regarding the impact of generation-specific measures and instruments cannot be entirely confirmed in view of the statements made by the company representatives.

It is particularly the active management of cognitive proximity in combination with physical proximity, as practised by the first generation of TPs, that can be seen as the centrepiece of the German TP concept and the foundation of interorganisational knowledge networking for organisations based on site. Accordingly, companies have the opportunity to find potential collaborators in direct proximity. Active support measures in the form of events and networks in line with the second TP generation, however, have sometimes proved to be intrusive and are largely avoided by on-site organisations, or seen as unhelpful.

By contrast, the many additional spatial design measures aimed at promoting interorganisational knowledge networking in a passive manner need to be aligned with the specific needs of the organisations based on site. In this context, it is not the aforementioned urban design features that promote networking, but rather conventional structures in the form of spacious canteens, which prove compatible with the monofunctional, work-oriented structure of TPs.

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