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past, present and future

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Chapter 13
Campus–City Relations: Past, Present, and Future

Alexandra C. den Heijer and Flavia T. J. Curvelo Magdaniel

The relation between the campus and the city is important for university strategies and urban ambitions. City–university partnerships are being encouraged because they are regarded as mutually beneficial to the stimulation of innovation, which is a common goal of municipalities and universities in the knowledge-based economy (Curvelo Magdaniel, 2016; den Heijer, 2011). These partnerships take place as joint initiatives such as network platforms, learning programs, entrepreneurial activities, and projects to improve their cooperation in tackling societal challenges.[1] To stimulate innovation for socioeconomic development, attracting and retaining talented students and highly skilled workers is arguably the most important joint task of universities and cities (den Heijer, 2011; van den Berg, Pol, van Winden, & Woets, 2005). Creating smart, healthy, inspiring, and appealing environments is therefore crucial for both organizations in the global competition for talent. Quality-of-life factors—such as affordable and desirable housing, diversity of people and functions, convenient commuting, efficient transportation, and cultural and green amenities—contribute to a city–university capacity to draw and keep talent (Drucker & Goldstein, 2007; Fernández-Maldonado & Romein, 2008; Florida, 2002; O'Mara, 1999; van den Berg et al., 2005). In this context the ways in which campuses and cities relate to each other become important because they collectively shape the particular dynamics related to innovation, society, and the economy by bringing in and retaining talent and by creating and applying knowledge for socioeconomic improvement of cities and regions.

[1]Examples of city–university partnerships are the EUniverCities Network launched in Europe in 2012 and the MetroLab Network started in the United States in 2015.

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The locations of universities play an important role in the competitive profile of cities and regions in the knowledge economy (Baltzopoulos & Broström, 2013; Florida, 2014). However, the simple presence of universities and their human capital is not enough to stimulate innovation and create wealth in cities. There are challenges for cities in exploiting and managing the provision of human capital as economic assets. Accordingly, managing the interaction between universities, industry, and governments is considered the essence of remaining competitive in the knowledge economy (Laursen, Reichstein, & Salter, 2011). This task involves managing the relationships among stakeholders within each of these organizational spheres, which are place-based. Cities and regions have the ability to optimize the cooperation between these spheres through different activities and at different levels (e.g., from strategic to operational). City–university partnerships can be considered instructive examples of strategic approaches.

At the operational level, investing in the development and management of physical infrastructure that supports the creation, diffusion, and application of knowledge can be seen as a way to strengthen these relationships (van Winden, 2008). In global policies, for instance, the organizational spheres and the infrastructure that support their activities are regarded as national science systems (OECD, 1996). The physical infrastructure—including the built environment—is thus an essential part of these systems. Florida (2010) outlines it in a general way as an enabler of innovation. He conceives of technology, education, and transportation as large-scale systems infrastructures that are needed to support the current demands driven by innovation, velocity, and flexibility. Similarly, he regards the physical infrastructure as a common supportive ground for these systems.

The perception of innovation as a process driven by the exchange of ideas has influenced the physical and functional ways in which campuses relate to cities. In this perception social dynamics are inherent in the early phases of knowledge creation, where ideas are developed and shared as tacit knowledge (Simmie, 2005). In regional studies there is the assumption that having firms and people with complementary intellectual backgrounds in close geographical proximity is also vital to knowledge creation (Audretsch & Feldman, 1996, 2004; Beaudry & Schiffauerova, 2009; Porter, 2008; van Oort & Lambooy, 2014). The more one facilitates social interaction, the greater the potential becomes for collaboration or the cultivation of ideas. These concepts have spread in urban studies because cities are seen as natural sources of diversity (of people and functions) and of positive environments for innovation (Florida, 2008; Glaeser, Kallal, Scheinkman, & Shleifer, 1992; Jacobs, 1961). Proponents of innovation districts as a new urban agenda also embrace the city as an optimal place for innovation and criticize the science park model (Katz & Wagner, 2014). These considerations are influencing the way in which campus location and campus functional mix are perceived in the knowledge economy. That perception is especially important because there are many different types of physical and functional campuses (den Heijer, 2011), each of which may have different capacities to stimulate innovation (Curvelo Magdaniel, 2016).

Raising awareness of the dynamic and diverse physical and functional relations between the campus and the city can help stakeholders in universities and cities improve the decisions they make, specifically the strategic decisions that efficiently exploit the physical and functional resources the campus and city share and that effectively support the mutual goals of universities and cities. We aim to deepen the understanding of dynamic campus–city relations by asking two questions: What are the past, present, and future trends in the physical settings and functional mix of campuses? How can universities and cities act upon these trends?

To elaborate on the physical and functional relation between campus and city, this chapter combines components of two dissertations (den Heijer, 2011; Curvelo Magdaniel, 2016) and builds on the findings reported in a journal article (den Heijer & Curvelo Magdaniel, 2012) and in research involving 39 case studies worldwide (Curvelo Magdaniel, 2016, 2017). The first section provides our theoretical framework. In the second section we describe the methodology used to answer our questions. The third section conveys our results through descriptions of past, present, and future trends in physical and functional relations between campus and city. In the fourth section we discuss the results and their implications for practice and theory. The final section offers this chapter's main conclusions in response to our central questions.

Conceptual Framework

To operationalize campus–city relations, it is necessary to define their physical and functional characteristics. To do so, we use components of earlier research (Curvelo Magdaniel, 2016; den Heijer, 2011; den Heijer & de Vries, 2007) and combine the resulting physical and functional typologies in a conceptual framework that we then use to position the past, present, and future campus–city relations of 39 cases as explored and assessed by Curvelo Magdaniel (2016).

Defining Physical Campus–City Relations

The term *campus* is often associated with a greenfield site (outside the city) or an area that is isolated from the urban setting (sometimes even gated). In practice this description does not necessarily apply. At universities the word campus is often used to designate where university activities take place. It also increasingly refers to a virtual campus or a downtown café (den Heijer, 2011). In this chapter we define the university campus as the sum of locations with predominantly university or university-related functions (see den Heijer, 2011). In other words, a collection of inner-city university buildings can be called an inner-city campus even though the borders are not altogether distinct. The typology in Fig. 13.1 illustrates this definition, identifying three different spatial configurations: (a) the greenfield campus,

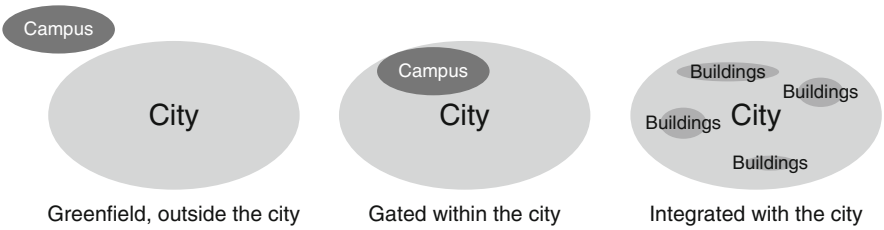


Fig. 13.1 Three different spatial configurations of physical campus–city relations.
Source and copyright: Den Heijer (2011, p. 53). Adapted and reprinted with permission.

outside the city, (b) the campus (gated) within the city and (c) the campus integrated into the city.

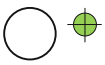
Whereas the term campus used to refer only to *university* land and buildings, more and more types of institutions have come to use it to refer to their territory. The terms *corporate campus* and *high-tech campus* (Hoeger & Christiaanse, 2007, p. 188), for example, refer to a specific location. In this study, however, the university campus can refer to more than one location or spatial configuration. In fact, recent research shows that many of the 14 Dutch research universities combine two or even three models to accommodate their rapid growth (TU Delft, 2016).

In analyzing location characteristics, Curvelo Magdaniel (2016) described the position of technology campuses in relation to their host cities (or regions). Her study showed that technology campuses entail a variety of built environments designed to accommodate technology-driven research activities of multiple organizations (e.g., science parks, campuses of universities of technology. and corporate R&D parks). Topology helped identify a set of five relationships that the campuses and the cities can have with each other (see Table 13.1).

Linked to specific changes in their temporal and social contexts, most of these relationships are dynamic. Most campuses studied by Curvelo Magdaniel (2016) are considered "touched by the city" (p. 441) because they are at the edge thereof. These locations could have come about in different ways. For instance, some campuses were built outside the city, whose expansion due to urbanization ultimately reached their peripheries. Perhaps these campuses also induced urban developments in their vicinities. Conversely, some campuses may have been built in inner-city locations where their full urban integration was impeded by particular urban configurations (e.g., a waterfront or natural features, which happen to be both geographic and administrative boundaries). Depending on each development and campus–city configuration, some campuses categorized as Touches may eventually evolve into Contains or Overlaps. Furthermore, Curvelo Magdaniel (2016) found that nine of the 39 campuses she studied have at least two relationships with the city. These locations can be considered campuses in transition,[2] for this duality has resulted

[2]Campuses in transition are those perceived as having two physical campus–city relationships simultaneously because of constant spatial transformations and individual campus–city features in terms of relative size, infrastructure systems, and/or natural elements.

Table 13.1 Typology of five physical relations between the city and technology campuses (N = 39)

Relationship	Description	Cases
Equals 	*City is the same as the campus*. It includes those areas that were newly built as towns or cities. They were built and planned from scratch to accommodate clusters of technology. They are located only in Asia.	4
Disjoints 	*City shares nothing with the campus*. It includes those areas located outside the city limits but not distinguished as independent cities.	8
Touches 	*City touches the campus*. It includes those areas bordering on the city. In most cases they and the city are tangent. Touches and the city are usually tangent, but in some cases they are separated by a river, highway, or some other feature).	17
Contains 	*City contains the campus*. It includes those areas that are inside the urban fabric, but they are perceived of as a distinct campus with borders (e.g., roads, fences, waterfronts, or natural features).	12
Overlaps 	*City and campuses have multiple points in common*. It includes those areas integrated into the urban fabric, and in many cases the boundaries between the sites and the rest of the city are not clearly defined or perceived.	6

Source: Adapted from Curvelo Magdaniel (2016, p. 114). Copyright by Curvelo Magdaniel. Adapted and reprinted with permission.

from certain campus characteristics in relation to changes in urban features (e.g., a growing campus with a large surface area and dispersed arrangement in a relatively small city).

Generally, the university campus in this research refers physically to the location (s) of the university or the ensemble of buildings that are either used or owned (or both) by the university and have a role in achieving the institutional goals. Three different types of locations are identified and used in the conceptual framework of this chapter: greenfield (the city disjoints[3] or touches the campus), gated in the city (city contains the campus), and integrated into the city (city overlaps the campus).

[3]For our chapter's conceptual framework, two of the five types of campus–city relationships identified by Curvelo Magdaniel (2016)—Equals and Disjoints—are merged into one (Disjoint) because their main difference lies in the scale of the development, which is not relevant for the descriptive purpose of this study.

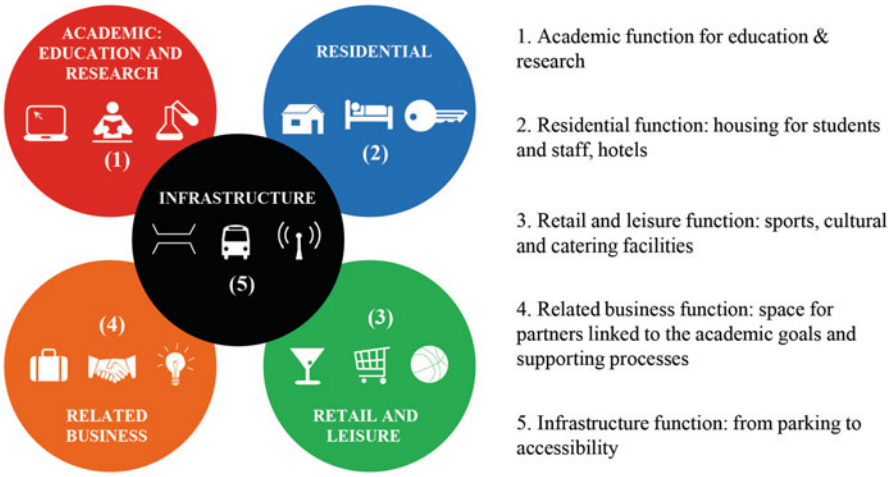


Fig. 13.2 Space types on campus—the required functional mix for the future university. Source: Den Heijer (2011, p. 181). Adapted and reprinted with permission.

Defining Functional Campus–City Relations

The functional campus–city relation describes how dependent the university is on the city's functions: How many functions do the campus and city share? Or is the campus an autonomous, self-contained city that is functionally independent of the city?

Developments in university strategies show that the university is becoming increasingly dependent on the presence of nonacademic types of space in their vicinity (Chapman, 2006; den Heijer, 2011; TU Delft, 2016). Examples are housing and apartments for foreign students or hotel capacity for visiting professors for promoting goals of internationalization. Trendy coffee bars and sports facilities are important for creating a lively campus and a place to meet on campus. To assure knowledge transfer, which most universities mention as their third strategic goal, it is crucial to welcome businesses that combine learning and working, incubators for entrepreneurs, and breeding grounds for young artists (Wissema, 2009; Worthington, 2009). Lastly, quality infrastructure and adequate parking space should guarantee the university's accessibility to students, staff members, and many visitors. The functional campus models are based on these five required aspects of university processes and goals (see Fig. 13.2), which have been specified by Dutch campus managers in workshops (den Heijer & de Vries, 2007) and confirmed in recent research (TU Delft, 2016).

The types of space and associated functions identified in Fig. 13.2—education and research, residence, retail and leisure facilities, related businesses, and infrastructure—are elaborated in Table 13.2, which explains the extent to which the city's facilities complement those of the campus in each functional category. The functional mix required by the university need not be supplied on campus. Depending on

Table 13.2 Required university functional mix specified by campus managers and supplied and managed by a university, municipality, or third party

Functions	Who manages/own/uses?			Similar city functions
	University	Municipality	3rd party	Alternative available in city? Examples
ACADEMIC • EDUCATION AND RESEARCH				
Classrooms and studio spaces (small groups)	X			
Lecture halls (large groups)	X			Movies, theaters
Office space academic staff	X			
Office space support staff	X			
Laboratories	X		X	R&D facilities of large companies
Study places for individual use/small groups	X			Inner city coffee bars
Library	X			Community library
Special places for ceremonies (graduation)	X	X		City halls, churches
Special conference facilities	X		X	Conference center
Special educational facilities (dance, media, arts)	X	X		Theaters, studios, museums
Academic hospital			X	Other hospital
Medical school			X	
RESIDENTIAL				
Student housing: national			X	Social housing in city
Student housing: international – short stay	X		X	Hotels or apartments
Alumni housing: young potentials, creative class			X	Housing supply in city
Faculty housing			X	Housing for expats
Housing for support staff			X	Housing supply in city
Hotel facilities			X	Hotels in city
Short stay apartments for visiting professors	X		X	
RETAIL AND LEISURE				
Sports facilities	X		X	Sport facilities in city
Book stores			X	Book stores in city
Coffee bars	X		X	Espresso bars in city
Student associations and societies/fraternities			X	
Restaurants (lunch)	X		X	Restaurants (lunch)
Restaurants (dinner)	X		X	Restaurants (dinner)
Bars	X		X	Bars
Theaters			X	Theaters
Jazz clubs			X	Jazz clubs
Cultural center, museum	X		X	Cultural center
Dry cleaning, day care center, supermarkets			X	Existing city facilities
RELATED BUSINESS				
Incubators (academic spin-off)	X		X	Office supply in city
R&D facilities of large companies			X	Business campuses
Related services (service spin-off)			X	Office parks in city
Business that combine learning and working			X	
Artists, creative professions			X	(Vacant) industrial buildings
INFRASTRUCTURE				
Parking space	X	X		Existing parking facilities
Transport on campus (trolleys)	X			
Accessibility (by car)	X	X		Car transport network city
Accessibility (by public transport)	X	X		Public transport network city
Public space (bicycles, pedestrians)	X	X		Bicycle paths in city

Source: Den Heijer (2011, p. 184), based on research results from den Heijer and de Vries (2007). Adapted and reprinted with permission.

the location of the campus(es) in the city, the urban functional mix can help meet the needs of the university.

The functional specifications in Table 13.2 also show that supplying and managing the required university functions is, in practice, not a management task of the university alone. When asked who manages, owns, or uses this function, the

respondents from many universities indicated that it was the municipality or a third party instead of the university. In 2006 the university's collaboration with the municipality and third parties was quite common as assessed by den Heijer and de Vries (2007) in workshops with both campus managers and urban authorities. Residential, retail and leisure, and related business functions are often managed by third parties.

According to this part of the conceptual framework, universities can benefit from the network of functions available in cities and supplied by university partners across places. The extent to which universities can benefit depends on the physical distance between campus and city functions. City–campus benefits depend on both functional and physical aspects, a circumstance that highlights the importance of connecting both dimensions in a conceptual framework.

Combining Physical and Functional Campus–City Relations

Den Heijer (2011) combined the physical and functional campus–city typologies as illustrated in Fig. 13.3. She identified the most common city–campus relations practiced at that time, including one without academic functions (called "business community," which was found in in three different physical, urban settings). In that study attention was given to six types of communities defined by types of functional mix: academic community, residential community, sociocultural community, business and science community, campus community, and business community. The academic and business communities are two functional extremes.

Academic communities refer to learning environments (Worthington, 2009), which are described as holistic, loosely coupled, on and off campus, formal and informal, and virtual and physical. In terms of programmatic requirements, learning environments should provide (a) spaces that are less specialized than traditional ones, where boundaries blur and operating hours approach 24 hours a day, 7 days a week; (b) types of space designed primarily around patterns of human interaction rather than specific needs of individual departments, disciplines, or technologies; and (c) new models of space that enhance the quality of life as much as support the learning experience.

Business communities are environments with a concentration of companies, a nexus that does not necessarily exclude a collaborative relationship with universities. In these settings research is a more representative activity on campus than teaching and learning are for academic communities. Existing research refers to these environments as high-tech campuses or corporate campuses (Hoeger & Christiaanse, 2007). Usually, governments acknowledge the potential economic power of these environments for cities and regions (Buck, 2012). Tenant diversity, shared research facilities, high-quality buildings, and spaces that facilitate networking are examples of programmatic requirements on these types of campuses (Buck, 2016).

Besides defining types of communities, den Heijer (2011) defined more detailed categories when crossing these functional types with the physical campus–city

Types of functions on campus and types of communities	Current location Campus – City - University		
	Village Campus City Outside city/ "Greenfield" campus	Park Campus City Concentrated within city/ "Gated" campus	Univer-city Buildings Buildings City Buildings Buildings Merged with city/ "Integrated" campus
Academic community	Academic village campus	Academic park campus	Academic univer-city campus
Residential community	Residential Village campus	Residential Park campus	Residential Univer-city campus
Sociocultural community	Sociocultural Greenfield campus	Sociocultural Park campus	Sociocultural Univer-city campus
Business & science community	Business & science Village campus	Business & science Park campus	Business & science Univer-city campus
Campus community	Campus village	Campus park	Campus university
Business community	Business village "Corporate campus" outside the city	Business park "Corporate campus" Gated within the city	Corporate city "Business district" within the city

Fig. 13.3 Physical and functional typologies combined to describe the most common campus–city relations. Source: Den Heijer (2011, p. 185). Adapted and reprinted with permission.

relations. These combinations provide a conceptual framework for the analysis of past, present, and future campus–city trends presented in this chapter.

Methods

We used the aforementioned concepts to describe the past and present trends in campus–city relations and to estimate their future course by comparing 39 cases worldwide.

Sample

We used an international sample of 39 campuses that had been part of an exploratory study on the relationship between innovation and the built environment (Curvelo Magdaniel, 2016). The campuses in this sample had already been classified according to the types of location characteristics consistent with the conceptual framework (see Table 13.3). These campuses emerged during the second half of the twentieth century, a period of significant technological advances in industrialized countries. Innovation has thus been a major driver of socioeconomic development in these countries. Our sample also focused on a wide range of campuses at which research is the main activity. It included not only university campuses but also corporate campuses linked to university research (27 of 39 campuses have university users).

Data Collection and Analysis

We drew on web-based documentation to collect two main types of data—physical and functional—as was consistent with the study's conceptual framework. The physical data focused on campus location (geographical coordinates using the main campus address). The functional data included (a) the main user's organizations (universities and firms to determine the academic and business functions, respectively) and (b) supporting functions (residential as well as retail and leisure to determine the mix of functions other than academic and business). This information was collected in 2013 as part of a wide exploratory study (Curvelo Magdaniel, 2016). The collected data was publicly available through various sources. Primary data sources included official websites of the campuses, institutional documents and reports, and open map software. Secondary sources included existing empirical research documenting the cases selected. Table 13.4 presents a summary of the data.

The combination of physical and functional campus–city relations was used to categorize and analyze the data for (past, present, and future trends. Tables featuring the different types of locations and mix of functions were developed to position the campuses within the existing categories based on the two types of data collected. Mapping the campus location enabled us to describe and interpret physical campus–city relations over time. For instance, historical imagery provided by Google Earth

Table 13.3 Sample of 39 campuses exhibiting the physical campus–city relationships identified by Curvelo Magdaniel (2016)

No.	Campus	City, state, and country	Campus–city relationship
1	Stanford Research Park	Palo Alto, California, United States	Touches/ Overlaps
2	Cornell Business & Technology park	Ithaca, New York, United States	Touches
3	TU/e Science Park	Eindhoven, The Netherlands	Contains
4	Akademgorodok Academic Town	Novosibirsk, Russia	Disjoints*
5	Research Campus Garching—Technical University of Munich	Garching/Munich, Germany	Disjoints
6	Research Triangle Park	Durham, Raleigh, and Chapel Hill, North Carolina, United States	Disjoints
7	ETH Hönggerberg Science City	Zürich, Switzerland	Touches
8	MIT Campus & University Park at MIT	Cambridge, Massachusetts, United States	Overlaps
9	Drienerlo Campus University of Twente & The Innovation Campus Kennispark Twente	Enschede, The Netherlands	Touches
10	TU Delft District & Technopolis and Innovation Campus Delft	Delft, The Netherlands	Touches/ Overlaps
11	Tsukuba Science City	Tsukuba, Japan	Disjoints*
12	Cambridge Science Park	Cambridge, United Kingdom	Touches
13	Sophia-Antipolis Park	Côte d'Azur Region, France	Disjoints
14	Taedok Science Town & Daedeok Innopolis	Daejeon, South Korea	Disjoints*
15	Hsinchu Science and Industrial Park	Hsinchu City, Taiwan	Touches/ Overlaps
16	Singapore Science Park	Singapore City-State, Singapore	Contains
17	Leiden Bio Science Park	Leiden, The Netherlands	Contains/ Overlaps
18	Surrey Research Park	Guildford, United Kingdom	Touches
19	Western Australia Technology Park	Perth, Australia	Contains
20	Otaniemi Science Park & Otaniemi Technology Hub	Espoo, Finland	Contains
21	Sendai Technopolis & Izumi Park Town Industrial Park	Sendai city, Japan	Disjoints*
22	Kansai Science City	Kansai, Japan	Disjoints
23	Zhong Guan Cun Science Park	Beijing, China	Overlaps
24	Technology Park Bremen & University of Bremen	Bremen, Germany	Touches
25	Brandenburg Technical University Campus	Cottbus, Germany	Contains
26	Zhangjiang Hi-Tech Park	Shanghai, China	Touches
27	Taguspark	Lisbon, Portugal	Disjoints
28	Berlin Adlershof Humboldt University	Berlin, Germany	Touches/ Contains
29	Shenzhen Hi-Tech Industrial Park	Shenzhen, China	Touches/ Contains

(continued)

Table 13.3 (continued)

No.	Campus	City, state, and country	Campus–city relationship
30	Tainan Science Park	Tainan City, Taiwan	Disjoints
31	High-Tech Campus Eindhoven	Eindhoven, The Netherlands	Touches
32	Science Park Amsterdam	Amsterdam, The Netherlands	Touches/ Contains
33	Biopolis	Singapore City-State, Singapore	Touches/ Contains
34	Taichung Science Park	Taichung, Taiwan	Disjoints
35	Biocant Park	Cantanhede, Portugal	Disjoints
36	Chemelot Campus	Sittard-Geleen, The Netherlands	Touches
37	Barcelona City of Knowledge	Barcelona, Spain	Contains
38	GIANT Innovation Campus [Grenoble Innovation for Advanced New Technologies]	Grenoble, Isère, France	Touches/ Contains
39	RWTH Aachen University—Research Campus Metalen	Aachen, Germany	Disjoints

*Previously categorized as Equals.
Source: Design by authors.

Table 13.4 Data collected on features of 39 campuses throughout the world

Content	Evidence	Sources
	Physical	
Main address Geographic coordinates	Campus's location characteristics in the city	Campus's official websites iTouchMap (open access online software) and Google Earth
	Functional	
Main user's organizations Supporting functions	Academic and business functions on campus Residential and leisure/retail functions on campus	Campus's institutional reports and existing empirical research Campus's institutional reports and existing empirical research Google Earth

Source: Design by authors.

made it possible to determine past physical relations and to prepare estimates of future spatial developments based on observations over the years since the emergence of the campuses. The estimation of dynamic functional trends on campus was more limited. The past and the future functional trends are based on institutional documents or statements in which the representatives of organizations serving campus users explicitly described how they have changed or intended to change functionally (e.g., by increasing or decreasing the number of functions on campus). However, this information was not available for all the campuses. In such cases the existing functional situation remained unchanged in the analysis.

Results

As shown by the overview of campus–city relations in 39 international cases in Fig. 13.4, each campus proved to occupy different categories, depending on the current physical and functional data pertaining to it. Figure 13.4 also illustrates our estimations of each campus's past and future position. Physical data from all 39 cases revealed that campuses exhibited detailed location characteristics already categorized (Curvelo Magdaniel, 2016; den Heijer, 2011). The combination of these physical relations is symbolized at the top of the figure. Functional data on 37 valid cases[4] showed that campuses allowed for a variety of functional combinations. Empirical data on the 39 cases expanded den Heijer's (2011) classification scheme from 6 to 11 types of community based on the different mix of five functional categories.

Trends in Physical Campus–City Relations

The physical data showed an enduring shift in campus development from peripheral to inner-city locations. Most of the campuses in the sample (36 of 39 cases) used to be on the periphery. Of the 39 campuses we studied, 22 remain outside the cities today, 10 are currently in the city, and another 9 campuses are in transition. These nine campuses exhibit the following dual relationships: Touches/Contains (five cases), Touches/Overlaps (three cases), and Overlaps/Contains (one case). The former two dual relationships illustrate the transition from peripheral to inner-city locations. The number of inner-city locations is expected to increase (i.e., 20 of 39 cases estimated). This trend substantiates the transformation of the current campuses into "integrated campuses," which are physically merged with the city.

Trends in Functional Campus–City Relations

The functional data showed an enduring shift from monofunctional to multifunctional campuses regardless of their distinct locations in relation to the city. This shift was illustrated by both extremes of the functional categories (i.e., a change from solely academic or business communities toward campus communities). Indeed, the number of monofunctional campuses had decreased from 13 of 39 cases to 3 of 39 cases. We also estimated that monofunctional campuses would decrease to 1 of 39 cases. Accordingly, the number of campuses that have all the

[4]Functional data on two of the thirty-nine cases was not found. Most campuses highlighted their functional mix in their institutional documents. It was safe to assume that these campuses were monofunctional and to categorize them as such.

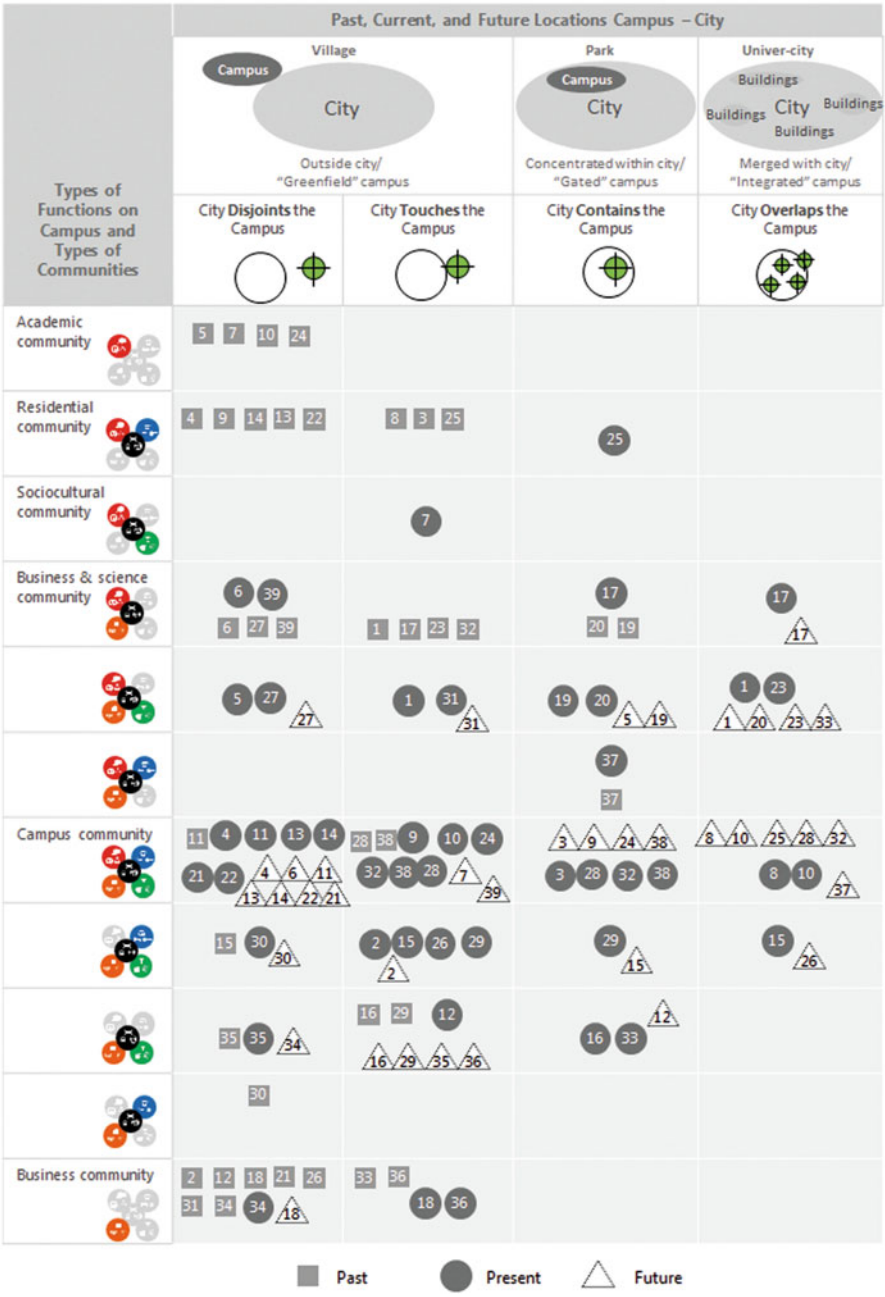


Fig. 13.4 Past, current, and future campus–city relations of 39 cases studied. Source: Design by authors.

required functions had increased over the years—from 3 of 39 cases to 16 of 39 cases. The estimations based on our research suggested that the number of multifunctional campuses was likely to rise to 19 of 39 cases. Overall, the combination of two or three functions was predominant (23 of 39 cases) and still is (20 of 39 cases), and we expect it to decrease slightly to 19 of 39 cases. This trend substantiated the transformation of the current campuses into campus communities that provide all the required functions.

Discussion

The results confirm research that has outlined the urban shift in the accommodation of universities and other technology-driven organizations in the knowledge-based economy (Aasen & Haugen, 2015; Carvalho, 2013; den Heijer, 2011; Katz & Wagner, 2014; van Winden & Carvalho, 2016). Our findings on the campus's shift from peripheral to inner-city locations confirms the work of den Heijer (2011), who documented the physical signs of universities transitions in the Dutch context. In changing from small and exclusive institutions to large institutions open to the masses, Dutch universities have built their campuses in three stages (see Fig. 13.5). First, universities in the early 1900s were small institutions physically integrated into the urban fabric. As they grew, their campuses expanded to the edges of the city (1950s through the 1970s), and some universities left their inner-city buildings to intensify the use of their newly built campuses. With the rapid urban growth of Dutch cities in recent decades, the university campuses are again becoming part of the city. The sample used in this study provides evidence of the latter two developmental stages.

In practice, the idea of the city as an ideal environment supporting innovative activities (Jacobs, 1961; Katz & Wagner, 2014) may be influencing location decisions of universities and other organizations. There are already extraordinary examples of universities in Europe and the United States organizing their move from suburban to urban locations rather than just waiting for the physical expansion of the city to happen (Aasen & Haugen, 2015; Lange, 2012).

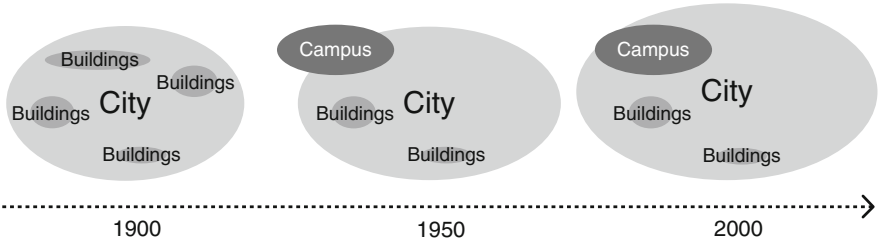


Fig. 13.5 Example of development stages that built some of the current Dutch campuses. Source: Den Heijer (2011, p. 61). Adapted and reprinted with permission.

The shift from monofunctional to multifunctional campuses supports the findings of Carvalho (2013), who observed similar trends while studying knowledge locations. Several campuses, science parks, and technology parks are being "urbanized" because new functions such as housing, amenities, and cultural facilities have been added to these places. Van Winden and Carvalho (2016) have argued that many places are being transformed from monofunctional business and research-oriented into diverse, open, and urban environments. The empirical data illustrating the past, present, and future functional trends away from exclusively academic or business communities and toward mixed campus communities strengthen these positions (Fig. 13.4).

These shifts in campus–city relations make evident that universities and other organizations on campuses increasingly share physical and functional resources with cities. These resources could be efficiently used and managed to attain shared goals (e.g., stimulating innovation and increasing sustainability, which are already on the agenda of universities and local governments alike). As illustrated in Figure 13.6, universities can benefit from the urban network of functions that is supplied by university partners across the city (den Heijer, 2011). Cities may benefit from the presence of university communities of students and knowledge workers, adding to the vitality of areas neighboring the campuses.

The current and future trends outlined in this chapter provide an opportunity for campus decision-makers to work together and mutually benefit from closer campus–city relations. However, there are two important conditions for such an endeavor's success: (a) the size of the city and (b) the commitment of the stakeholders. First, the potential success of campus–city relations depends on the distance between the city and the campus, which is influenced by the degree of accessibility afforded by public transport. This dependence is critical for campuses located on the periphery. Depending on the size of the city and its available transportation modes, this distance ranges from 12 minutes (e.g., for Technology Park Bremen) to 2 hours (for the Sophia Antipolis Park). The size of the city makes a significant difference in the opportunities to share physical and functional resources.

Second, successful relations between a campus and a city require the commitment and active participation of the campuses' and the city's decision-makers, who may be willing to assume different roles to achieve their mutual goals. Just as the borders of the inner-city campus are unclear, so are the boundaries defining the types of stakeholders who have to be involved in managing it (e.g., owners, users, policy-makers, and beneficiaries). Although such ambiguity may come across as a threat to campus governance, many universities and other organizations of campus users still want to be in (or near) the city because of the liveability, convenience, and abundance of its places for breeding innovation. Taking advantage of these opportunities requires coordinated management of campus–city relations.

In this context it is worth pointing out those campuses that are currently changing physically and functionally. Campuses in transition can be used as living labs to exploit the aforementioned opportunities and test the ways stakeholders may act on these trends. We have identified several of the campuses whose urban transition is physically evident. Some of the greenfield campuses, however, leave us uncertain

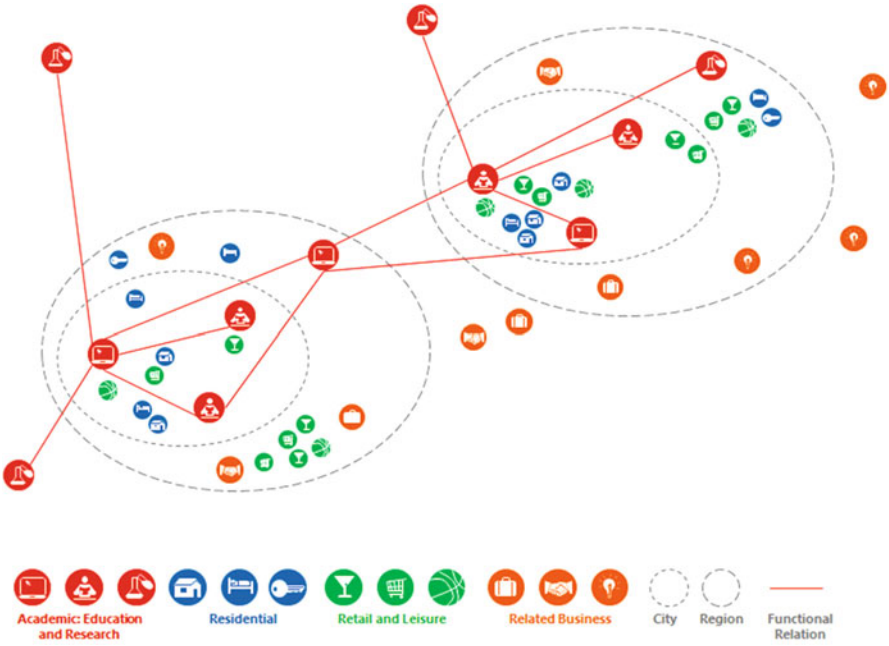


Fig. 13.6 Required university functions in a fictitious example, supplied by a network of university partners in neighboring cities or regions.
Source: Den Heijer (2011, p. 183). Adapted and reprinted with permission.

about their physical and functional integration into cities. In these instances, there is a need to be aware that efficient transportation infrastructure and the provision of multiple functions may prevent these campuses from becoming functionally self-contained. (Curvelo Magdaniel, den Heijer, & de Jonge, 2018). Nevertheless, the decision to be the city or part of the city depends on the campus decision-makers, the type of organization they support, the size of the city, and the campus-city distance as measured in travel time.

In summary, there are two extreme campus settings, each with its planning advantages and disadvantages. The functionally self-contained greenfield campus may encourage universities and other organizations on campus to remain relatively autonomous in creating their future campuses. However, campus development becomes relatively expensive for these organizations because they will underuse—if not neglect—the associated advantages of the campus–city relations. This model is not always voluntarily chosen; it can also be an unintentional or imposed strategy if the physically isolated setting is the sole option. The greater the campus–city distance is, the more complex the relation to the city becomes, both physically and functionally. By contrast, the campus integrated into the city has the advantage that there is plenty of opportunity to collaborate with the municipality and third parties. Disadvantages of this model are that the space for campus expansion is limited and

that the university's identity can be diffuse, a characteristic that might affect the sense of community.

Overall, the possibility of sharing functions or having other parties supply them does not mean that the university should take it. Some universities choose to manage and own most university functions themselves in order to keep control over functions that are crucial for achieving the university's goals. However, exclusive use, ownership, and management also come at a high price for the university, competing with primary resources for education and research. The actors responsible for universities should consider these advantages and disadvantages when selecting future campus models. In terms of management information, they are looking for references and experiences of other universities on which to base their choices. Further case studies may help universities make these challenging campus-related decisions.

Conclusions

What are the past, present, and future trends in the physical settings and functional mix of campuses? How can universities and cities respond to these trends? We have answered the first question by providing a descriptive overview of the changing physical and functional relations between the campus and the city in 39 international cases. Two main shifts were identified through observation of the developments between the past and the current situations and through estimation of the future changes. The first shift is a physical one from peripheral to inner-city locations that exhibit the dynamics of urban growth affecting the accommodation of universities and other organizations on campuses. The second is a change from monofunctional to multifunctional campuses in academic and business communities alike, which manifests opportunities and hazards of collaborating and competing in campus–city planning. Discussing these results to answer the second question, we raise awareness of the changing and diverse campus–city relations exemplified by two extreme models: the functionally self-contained greenfield campus and the campus integrated into the city. These models illustrate profound transformations from autonomous campus development to coordinated campus–city development. We have explored the advantages and disadvantages of each model to help stakeholders in universities and cities make better decisions that support their mutual organizational goals.

The empirical findings of this study have improved the existing conceptual framework on both the physical settings and the functional mix of campuses. First, it has added detail to the picture of campus–city physical relations by combining insights from den Heijer (2011) and Curvelo Magdaniel (2016). Second, by increasing the empirical data base, we have expanded the types of functional communities to include the combination of functions (den Heijer, 2011). For instance, the different types of campuses in the sample suggest that several campus developments are driven by business communities without universities (e.g., R&D parks). This

knowledge augments the literature on campus planning and may be helpful to other researchers investigating campus–city relations.

Our study also has limitations. Although the sample used may be representative of the variety of existing campuses, a larger sample may be more appropriate for interpreting these developments more accurately as trends with global impact. Moreover, this study's assessment of change from current to future relations between cities and campuses is based mainly on interpretations of statements in institutional documents (functional relations) and formal analysis (physical relations). Further research on this topic will require the use of more appropriate methods to estimate the changing physical and functional relations in the future. Case studies may have a part in contributing to an understanding of the dynamics explaining such changes and, ultimately, may help universities, cities, and other organizations act on these trends.

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