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# Technopolis – Beyond Technology Park

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**Abstract.** Recent decades have been characterised by the development of new fields of science and economy, including the sector of advanced technologies. Growth of the knowledge-based economy is associated with a new type of space. Technopolis, science and technology parks, have been springing up in cities all over the world. In urban terms, these are building complexes fulfilling functions of services, offices, laboratories, and industry, located in landscape arranged areas. The Author's long-term study of technology parks around the world oscillates around the quality of their space, their compositional principles, and relations with their surroundings, as well as facilities of public areas, city structure, and spatial policy. Some technology parks are simple, intimate building complexes surrounded with greenery. Their significance for the city is not always visible. However, many examples indicate that technology parks are more than a complex of buildings with office, laboratory, and industrial functions. They have a strong potential to change the city structure, by influencing social changes, increasing landscape and greenery, node places, and network connections. The Author believes that the emergence of technology parks has affected the development of a new mode of city functioning, its form, and space. Technology park complexes are morphologically distinctive from their surroundings due to their new forms and high-quality space. Therefore, the Author defines a new type of urban tissue – techno-polis - through four mutually complementary aspects of the urban structure: function, space, form, and community. The core of the techno-polis fabric is providing the best working conditions for highly skilled, professional staff, working in research centres and high-tech companies, and incidentally building a network community, changing the city's structure, and ensuring sustainable development. Techno-polis is a hybrid hub, which integrates high-tech industry with high-quality urban and architectural solutions. This attractive space with a considerable share of arranged greenery areas is a new eco-friendly quarter, where people can live and work in comfort.

## 1. Introduction

The turn of the 20<sup>th</sup> century was characterised by rapid growth of technology parks<sup>1</sup>, which are the main centres of knowledge-based economy. Their presence, on the other hand, testifies to the innovative development of the city. The first such centres started to emerge as early as in the mid-20<sup>th</sup> century. They were located in the suburbs or even beyond administrative limits of cities. Since the mid-1980s this function appeared in the compact urban structure, often in its central part. Its implementation often entailed investments which were strategic from the perspective of spatial policy. Introduction of a new function and related land use, which had been absent from the urbanised structure before, contributed to

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<sup>1</sup> The name “technology park” is used here as a synonym of such terms describing innovation centres as science park, science and technology park, research park, technopolis, city of science, technopark, etc.



the development of compact areas of cities of different sizes. Despite the fact that this tissue remains fully connected with the city, it constitutes a legible, separate unit. The degree of its development and diversity of its spatial forms, as well as the quality of architectural and urban solutions create a more or less attractive image of space. Is it a true novelty in the structure of the city? Does it influence its form, architecture, and life?

## 2. Methodology

The Author supports her deliberations with long-term observations carried out within the scheme of research into space and functional and structural relations of several dozen technological centres from all over the world. The observations were carried out in situ, as well as by analysing planning documents and orthophotomaps. In selected parks the Author carried out interviews with employees referring to the development of technoparks and the principles of their architecture and land development. The investigated technology parks are usually located within the urban structure and their implementation is linked with different aspects of the spatial policy of the city. Considering their sizes, we deal here with centres which do not go beyond one building, through a closed complex of facilities, a city block, to the entire district or a larger independent urban complex [1].

Irrespective of the sizes of these centres, each of them constitutes a unit that stands out in the structure of the city and exhibits a distinct programme and spatial form. Interestingly enough, in most locations globally, such centres are very similar. It is particularly well visible in cities where the morphology of the urban tissue and the traditions of building cities are different than the European ones. Examples of numerous technology parks point to the existence of a new urban tissue, which has its characteristic function, space, structure, and community [2].



**Figure 1.** Dynamic façade. Building of the laboratory of Ferdinand-Braun-Institut, Leibniz-Institut High-Frequency Technology in WISTA Adlershof, Berlin, made of photovoltaic panels

### 3. Function

In innovation centres the contemporary science, trailblazing discoveries, and human creativity are bound with economy. Their application and implementation in different technologies contributes to the emergence of non-tangible assets, new products, services. Such places are science and technology parks, technopoles, large-format science and technology complexes fostering the development of advanced technologies, cities of science. They are equally important for the knowledge-based economy as steelworks and mines used to be for the development of the industry of the 19<sup>th</sup> and 20<sup>th</sup> century [3].

From the point of view of the spatial policy, there is no uniform system of planning provisions of the use of land in technology centres in European cities. In some cities technology centres are included in spatial development plans as industrial, commercial, or mixed areas. Such provisions do not always fully facilitate conducting business activities characteristic for this specific function. Simultaneously, technology parks can be regarded as special areas or areas defined as technology parks, accordingly to their function. Such provisions, frequently encountered in many cities in Italy, France, Germany, and Poland, secure the desired specificity in the approach to planning, designing, and developing these areas [2]. Separating the type of use “technology park” in the spatial development plan testifies to the specificity of this function and to the intuitive understanding of its otherness, distinctness from other elements of the spatial structure of the city.

These are areas where the industry of advanced technologies develops, where software and components are manufactured, as well as where all sorts of services are provided, such as e.g. R&D services, business environment services, services relating to business incubation, support, and operation [4]. Hence their functional structure is diversified, and sometimes, especially in the case of larger urbanised projects, it is additionally connected with residential and commercial architecture. In the functional programme of the technology park the fundamental role is played by companies of advanced technologies, innovation centres, technology incubators, laboratories, research units, and higher education institutions. The buildings housing them have a characteristic architecture related to new technologies and ecological solution ‘figure 1’

Within the scheme of close mutual cooperation between the sector of science and research on one hand and production on the other, frequently implemented within science and technology clusters, a synergy of activities emerges, which fosters the occurrence and diffusion of innovations, technology transfer, and consequently the creation of advanced products and services. Such centres are interconnected globally by means of cooperation networks exhibiting different levels and degrees of intensity, influencing economic relations in the global scale. [5]

### 4. Space

Innovation centres are characterised by a very special type of space, shaped in the urban as well as architectural scale. Owing to its nature, different than the nature of the previously existing ones, as well as the high quality of solutions applied, this space constitutes an important landmark in the city, an element of identity of the new industrial reality.

In the investigated examples, space in the urban scale is formed as a landscape and park complex of the city block interior, square, or street with a pedestrian zone, completed with arranged greenery and street furniture. An important element in the structure of this space is the architecture of buildings and its aesthetic expression, as well as tall greenery, which constitutes walls closing urban interiors ‘figure 2’. In the architectural scale special attention is paid to designing the form of the building so as to provide an interesting solution of the entrance zone and the common parts of the building interiors. Frequently these elements are present in complex systems, creating a diversified network of social interiors, which make up an innovative technological space ‘figures 3, 4’. Its specificity results from a relationship between forms of the public space, such as a square, a courtyard, or a street, and landscape forms, such as an English park, a municipal park, a green square, or a garden.



**Figure 2.** 300-metre-long glass passive façade of the technology center, covering a gallery that integrates individual wings of the building, is opened on greenery and an artificial lake



**Figure 3.** Landscape project in Graphisoft Park, Budapest – an important element attracting employees.

Relationships with green areas, the presence of waterbodies, high-quality architecture, care for aesthetics, and application of a uniform architectural detail in the form of information signs, bollards, lamp posts, dustbins, and benches contribute to shaping of a harmonious picture of this space. Its individual components, complementing each other, make up a diversified, attractive architectural and urban project, offering a number of places of integration and interaction. Their presence fosters the shaping of an attractive work environment, whose form encourages discussion and contacts among workers, which underlies every manifestation of creative behaviour and innovation [6].



**Figure 4.** Microspace in Vienna Biocenter, Vienna. Development of the city block interior in front of the entrance to the building for recreational purposes: recreational meadow, square with benches, a fountain, and a sports field



**Figure 5.** Structure – view of the tissue making up the technology park in Dortmund

## 5. Structure

Most investigated technology parks exhibit similar tissue morphology, characterised by the legibility and homogeneity of form, irrespective of their geographical location. Their shape, stemming from the tradition and culture of University campuses, differs from other city-genic structures ‘figure 5’.

In terms of use, the structure of these area is made up by development blocks differing in sizes, and open areas, comprising recreational greenery areas, piazzas and squares, passageways, and car parks. With the exception of examples located in some big cities and metropolises, the development form is shaped by uniform sizes of buildings not taller than four floors and harmonious architectural solids. This

tissue takes the form of five main development systems: solitaire, city block, city quarter, belt system, and complex system, characteristic for large-area parks [2].

In general, the urban project is dominated by open spaces, where the development quality influences the spatial expression of the technology park. In complexes which are attractive in spatial terms, a vast area is occupied by arranged greenery. In such centres the biologically active area ratio is 50% on average, and the share of built-up areas oscillates at the level of 20%. Obtaining such a big share of greenery in the development structure of the complex results from the presence of common arranged recreational grounds, the application of lawns, hedges and tree lines in the design of car parks, and green roofs. A special part in the process of shaping of the structure of technology centres is played by tall greenery, which lines passageways, creating a friendly atmosphere and legibility of the system in space. The way buildings are arranged in open areas makes up the spatial system exhibiting diversified degrees of composition. The typology of spatial systems, with five types of compositional projects: free, cluster, arranged, chessboard, and compact [2], reflects the evolution of the structure of technology centres. Initially, it was a free form in the suburban landscape. Today most newly-built centres constitute arranged and compact systems integrated with the space of the city.



**Figure 6.** Space integrating employees inside the city block InfoPark, Budapest

## 6. Community

The main capital for the development of the knowledge-based economy are people and their intellectual potential. Hence an important element of activities of the technology park is the existence of a community which constitutes the foundation for creative development and cooperation. It is a multi-level and diversified community, consisting of numerous micro-communities. It comes into being in the work place through informal relations, supported by the park organisers by means of meetings and trainings, sharing interests and using the same means of transport, services, sport spaces or educational institutions for children. At the same time, due to the presence of branches of global companies in technology parks, employees of which are in constant contact, this community largely depends on virtual

relations. The presence of many engineers and scientists from different parts of the world in technology centres contributes to the emergence of a specific community, characterised by a very specific attitude to work, creativity, and its own lifestyle [6], as well as culture and behaviour system [3].

The process of animating social relations is supported by team-building activities and a properly selected functional programme. Simultaneously, interpersonal relations are fostered by a diversified network of public and social spaces, inscribed in the structure of the technological centre, as well as its appropriate functional and spatial organisation ‘figures 6,7’ Thus, the need of cooperation and maintaining constant interpersonal contacts within the scheme of informal networks of interpersonal relations considerably influences the functioning, shape, and atmosphere of the technology park.



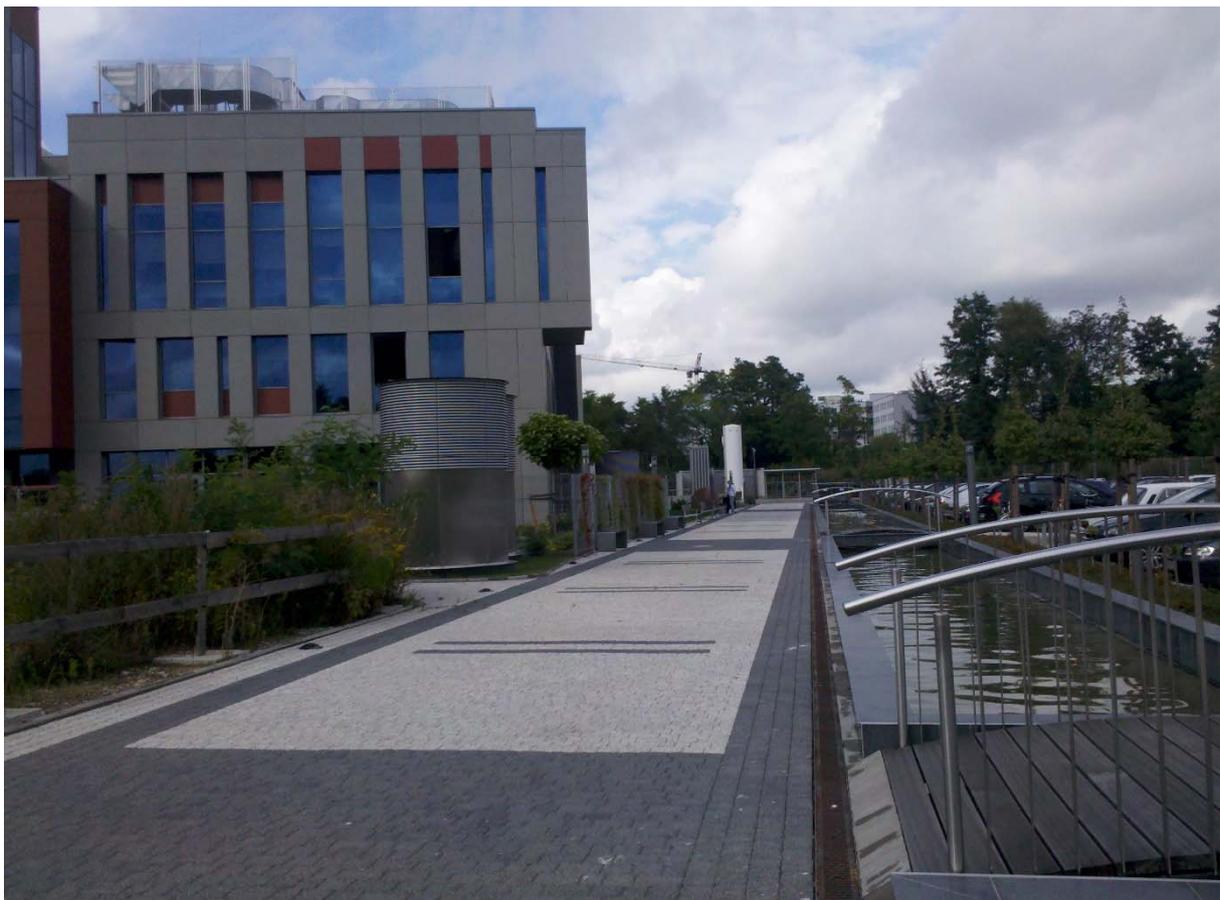
**Figure 7.** Robert Hochner park as the main social space in the Neu Marx, Vienna

## 7. Results and discussions

In many examples of technology parks the urban project entails the implementation of important buildings and arranged and well-tended public spaces, with a large share of green areas. These are centres which thanks to high awareness of local authorities have been properly designed and, reaching their full development, have a positive effect on the city structure, its image, and functioning on the economic level. Within their perimeters attractive space and state-of-the-art structure accompany the sector of advanced technologies, creating an appropriate environment for establishing interpersonal relations. Through their function, space, structure, and community they form a new type of urban tissue – techno-polis. It is a part of the city or an independent centre, morphologically distinct from the surrounding area, with a new, characteristic tissue and form and top-quality spaces, creating the best working conditions for highly qualified professionals cooperating with the local research and scientific centres, and companies from the sector of advanced technologies. At the same time, due to creating strong urban, environmental, and traffic-related links, it constitutes a strategic element of the development of the city [2]. At the stage of techno-polis, the technology park is no longer just an element of the economic structure of the city, but it enters a higher level as an important space in the city – its integrated element, constituting a specialised district or quarter. Achieving this stage opens up the possibility of shaping the city of the future, the smart city, rich in digital systems and pro-environmental solutions. The introduction of areas of arranged greenery, especially of tall greenery, is crucial not only for the space of the park itself, but most of all for the natural system of the city, particularly so in the context of the role of the environmental aspect in the creation of cities of the future [7].



**Figure 8.** Public space – streets in the Krakow Technology Park in Pychowice – the only public connection between building complexes.



**Figure 9.** Arranged pedestrian passageway in front of the Delta building in Wrocław Technology Park

Undoubtedly, achieving this level calls for integrated activities at the stage of spatial planning, vision formulation, urban design, as well as consistent implementation of planned solutions. There are about forty technology parks at different stages of development in Poland at the moment. Their operation demonstrates efforts to provide functional diversity, to build technology clusters and networks supporting the development of communities. Frequently their location in the city structure seems accidental and inadequate to the strategic role they play in the contemporary economy. In terms of forming of the spatial structure of Polish centres of innovation, one can observe a considerable deficit of recreational and green areas, which with the excessive burden of car park zones contributes to shaping open spaces which are not particularly attractive. The lack of pedestrian passageways between individual buildings, arranged lines of trees and shrubs, green squares or city block interiors, which could be places of stopping by, relaxation, informal conversations, constitutes a true weakness of spatial solutions adopted in Polish technology parks ‘figure 8’. Meanwhile, the quality of space is responsible for their superior function – creation of conditions fostering creative and innovative thinking, the sense of well-being, establishing interpersonal relations, discussions. As a result, very rarely does their space have the chance to play the role of an initiator of interpersonal relations. It is worth emphasising that in recent years, thanks to the growth of knowledge and financial support from the European Union, individual projects have been implemented in many parks, improving their spatial attractiveness ‘figure 9’.

## 8. Conclusions

The emergence and development of technology parks contributed to the emergence of a new form of urban tissue – techno-polis, which is determined by four mutually complementary aspects of the city: function, space, structure, and community. The superior objective of the techno-polis is providing the best possible working conditions and the development of networking amongst highly qualified professionals employed at research centres and technologically advanced companies. This process is supported by arranging places fostering interpersonal relations, where everyday activities of employees cumulate. Simultaneously, it is an important structure for the space of the city, often implemented as an urban project with a big share of green areas and top-quality aesthetic solutions. In Poland, the city-genic significance of technology parks is still underestimated, which results in the poor quality and attractiveness of their space.

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