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THE INDUSTRIAL SPECIALISATION OF SCIENCE AND TECHNOLOGY PARKS THROUGH THE EXAMPLE OF ZALAZONE PARK

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Science and technology parks provide an integrated environment where industrial companies, service sector actors and R&D activities can operate in a coordinated way, fostering the development of innovation ecosystems as well as increasing the competitiveness of the region. The theoretical background of science and technology parks is presented to support this theme, highlighting industry specificities and their impacts. The aim of this thesis is to examine, through the example of ZalaZONE Park, the sectoral aspects of science and technology parks that play a crucial role in the development of cooperation between the actors operating in the Park. Since 2020, ZalaZONE Park has been a full member of the International Association of Science Parks and Areas of Innovation (IASP), which brings together science parks and innovation centers from around the world. In this context, the industry and technology profile of the Park is compared with the data published by the IASP Global Survey 2022. The research is based on two main methodological approaches. Firstly, it groups the organizations operating in ZalaZONE Park according to their activities. Secondly, it classifies the actors according to their technological focus, revealing the correlations between industry and technological orientation. In the final analysis, the mapping of collaboration opportunities between the actors in the Park highlights the impact of sector specialization on the diversity of cooperation. The analysis of this theme will help other science and technology parks as well as innovation ecosystems to develop more effective strategies to increase their competitiveness. While research has typically defined industry orientation by focusing on technology, the present study adopts an analytical approach based on activity data and collaboration potential.

Keywords: cooperation, science and technology parks, sectoral and technological focus

1. Introduction

The main aim of this article is to analyze the sectoral issues of science and technology parks (STPs) through the case study of ZalaZONE Park, as sectoral questions might be key factors in establishing cooperation between actors in the Park.

As a basis for this paper, first, the background of science and technology parks is presented, emphasizing the specificities of the sectoral environment and their influencing effect. Following the theoretical overview, the study examines the diversity of the sectoral focus from three different perspectives: NACE code (NACE Rev. 2 is the statistical classification of economic activities in the European Union). sectoral focus and technological orientation. Based on these perspectives, ZalaZONE Park is placed in the activity-based classification system of innovation ecosystems, the analysis of which provides an opportunity for other science parks and areas of innovation (AOIs) to carry out a self-assessment according to the outlined framework, thereby outlining new strategic directions. The results will also be compared with the network of contacts in the Park to reveal possible connections between sectoral focus and the diversity of relationships, encouraging further self-reflection with regard to science parks to support the creation of new development paths.

ZalaZONE Park provides a platform for numerous research institutes, industrial partners and governmental actors to develop their joint research and scientific activities. The Park was established next to the automotive proving ground in Zalaegerszeg in 2019, so one of its focus areas is aimed at testing and developing autonomous vehicles as well as intelligent transportation systems.

The activities of the Park support the realization of the following goals:

- increasing the industrial and R+D attractiveness of the region,
- exploiting the modern park infrastructure, promoting industrial and economic cooperation between actors and the university sector,
- strengthening cooperation between partners through student projects,

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- linking dual and apprenticeship programs to meet specific industry as well as research and development needs.

Since ZalaZONE Park and the surrounding region is rapidly developing, the established business strategy integrates continuous innovations, complying with market changes and current trends. The proper management of the sectoral focus provides an opportunity to create future strategic directions.

2. Experimental

2.1. Samples and measurements

Much research has shown that innovation ecosystems exist in different forms with different specificities. An analysis [1] divided ecosystems into three groups: business, innovation and knowledge ecosystems. Oh et al. [2] mentioned seven types of ecosystems: corporate (open innovation) ecosystems, regional and national innovation ecosystems, digital innovation ecosystems, city-based innovation ecosystems and innovation districts, high-tech SME-centered ecosystems, incubators and accelerators, as well as university-based ecosystems. Pereira et al. [3] grouped them as follows: technology incubators, technology innovation centers and technology parks. They detail the characteristics of business, innovation and platform ecosystems related to the professional activities of that ecosystem. The authors pointed out that platform-based innovation ecosystems are, in particular, where actors are organized around a specific technological theme. Cobben [4] analyzed four types of ecosystems: business, innovation, entrepreneurship and knowledge ecosystems.

According to related research, ecosystems that differ in terms of their nature have different characteristics and it is advisable to also examine them from the point of view of activity characteristics. The activity characteristics can be interpreted regarding the mentality of the sector of actors operating in ecosystems and the technologies used. Based on research on innovation ecosystems, it is essentially agreed that these ecosystems do not fit into the classical customer-supplier relationship, represented by the value creation model of the earlier Porter model [5]. In innovation ecosystems, the focus is on innovation as well as the set of components and complements. Adner [6], the author of the original approach, approaches the ecosystem as "collaborative agreements" through which companies combine their individual offerings into a coherent, customer-centric solution. Therefore, it is extremely important to understand how the actors interact with each other and how interconnectivity is possible through their activities or technologies. If interconnectivity within the ecosystem is not sufficiently efficient, the innovation ecosystem cannot achieve its maximum level of performance. This aspect has been analyzed in a number of related studies, namely Adner [7]; Adner and Kapoor [8] and Kapoor and Lee [9].

The role of technological areas is therefore decisive because it is an important condition for connected value creation. The works of Gawer and Cusumano [10], Ceccagnoli et al. [11], Jacobides [12] and Cennamo [13] are cited in this regard. The analysis of Wareham et al. [14] highlights the role of companies that are decisive in the value chain of the ecosystem, indirectly referring to the issue of concentration. According to Winden and Carvalho [15], the physical proximity of companies to various industries can provide synergy and innovation through collaboration between otherwise disparate disciplines. This is particularly important in terms of geographical concentration as this synergistic effect can underpin park-like ecosystems and is one of the topics addressed on these sites. In the related literature, research into the sectoral analysis of geographically concentrated innovation ecosystems is very limited. One exception and very thorough analysis is the work of Liberati et al. [16] based on the processing of the double-digit NACE codes of 548 companies. As a result of a systematic examination of technology parks, the paper identified four types of forms: generally dispersed enterprises from a wide range of sectors; a mixture of sectors where the concentration is neither too high nor too low; a specialized environment where the majority of enterprises are concentrated in a few sectors; and no variant identifiable in terms of concentration. The authors of the current paper addressed this issue in detail in their earlier work [17] which will be referred to later. The present analysis is also related to a previous work presented by the authors at an ICED conference [18].

Science and technology parks, which are the subject of the present analysis, can be considered as specialized innovation ecosystems. One of the most thorough reviews on this topic is the work of Albahari et al. [19]. In the introduction of another paper [20], Albahari defines technology parks as a specific subset of agglomerations, which well describes the dual role of these ecosystems. On the one hand, they are geographically defined, park-like systems, while on the other hand, are structures closely related to their regional environment. Related research concerns many aspects of science and technology parks, e.g. the satisfaction of residents, success of parks, service characteristics, role of universities, etc., while sectoral and technological specificities have been addressed less. This is precisely what makes the present paper unique, albeit on the example of a park, but with regard to the international science and technology park community.

2.2. Theoretical methodologies

The research methodology is based on two aspects. Firstly, it groups the organizations that have settled in ZalaZONE Park according to their field of activity. Secondly, it organizes the actors according to their technological focus, assessing the relationship between their sectoral and technological focus. Finally, the map of

cooperation opportunities between the actors at ZalaZONE Park points out the connection between sectoral focus and diversity of cooperation.

The methodology is based on the classification of science and technology parks according to sectoral concentration and sectoral diversification (*Figure 1*). On the vertical axis, in the case of sectoral concentration, either a dominant sector is present or cannot be named. The degree of sectoral diversification can also vary, with many or fewer sectors named. On this basis, the following four fields should be interpreted [11]:

1. diverse, varied
2. few kinds
3. diverse, there is a professional direction
4. few kinds, there is a professional direction.

According to this study, the sectoral nature of innovation areas can be characterized by the duality of sectoral diversification and sectoral concentration [11].

By applying this approach, the sectoral character of ZalaZONE Park can be determined. Although only a few studies in the literature deal in such depth with the sectoral nature of science and technology parks, a strong connection between the activity-based classification method of innovation ecosystems and the current research is found, offering a basis for further research development.

The present study analyses in detail the relationships, similarities and differences between sectoral grouping according to NACE, the sectoral grouping formed as a result, and the technological classification, thereby determining the classification section.

3. Results and analysis

In the following section, the relevant data from the summary of the public version of the research compiled in the International Association of Science Parks and Areas of Innovation (IASP) Global Survey 2022 were used. The chapter "Sectors" of the survey was used to analyze activities and specialization, comparing this with the case study of ZalaZONE Park.

After comparing the data, specific charts addressing ZalaZONE Park are shown to reflect the diverse

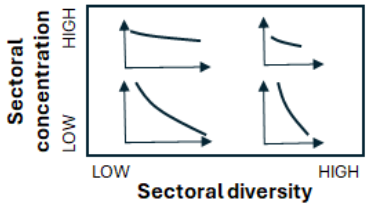

Figure 1: Activity-based classification of innovation ecosystems

analytical possibilities of the sectoral focus, revealing similarities and differences. The results obtained will be further evaluated according to the activity-based classification method of the innovation ecosystems already referenced. Finally, parallels between the multiplicity of the obtained outputs and the network of relationships will also be explored.

Based on *Figure 2*, it can be seen that in the case of international examples, 50% of the participants are engaged in manufacturing activities with restrictions, while the main profile of ZalaZONE Park does not focus on manufacturing activities.

Next, the details of the technological focus areas are presented in *Figures 3a* and *3b*.

The chart on the left depicts the technological focus of parks involved in IASP representing 113 respondents. It can be seen that info-communications and telecommunications, computer technology and hardware, software development, biotechnology and energy are the most widely used technologies in the cases examined as these processes shape the operation of the market globally. In comparison, in the portfolio of ZalaZONE Park, the focus of the automotive industry can be observed on the right-hand side by applying artificial intelligence, thereby complying with market processes.

In relation to the technological focus of ZalaZONE Park, business and industrial services, metrology and services, as well as mechanics and components are the most decisive aspects. Business and industrial services, comprising 78%, should be highlighted from the list of other technological focuses, which includes scientific as well as research and development activities, business management, management consulting and real-estate transactions.

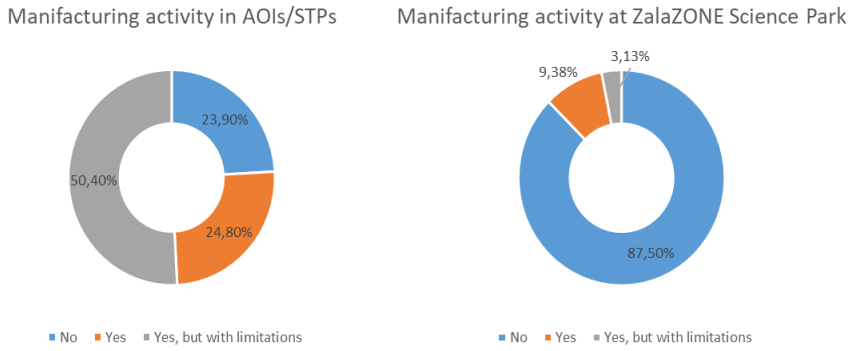

Figure 2: Manufacturing activity

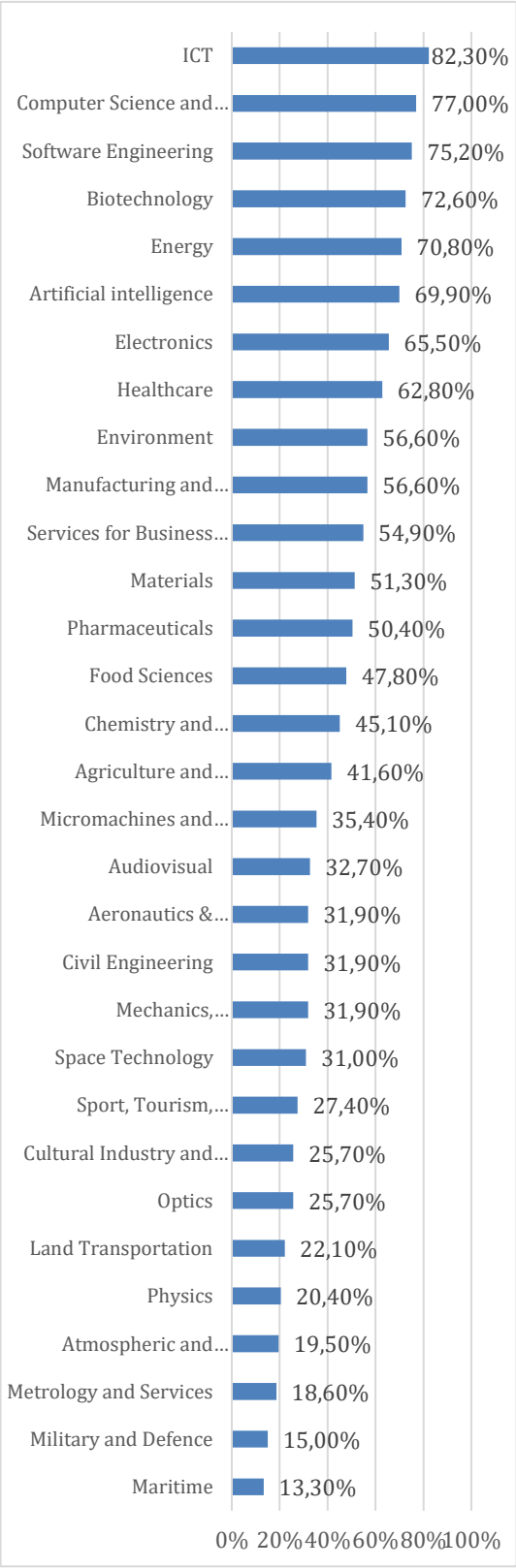

Figure 3a: Technology sectors found in AOIs/STPs

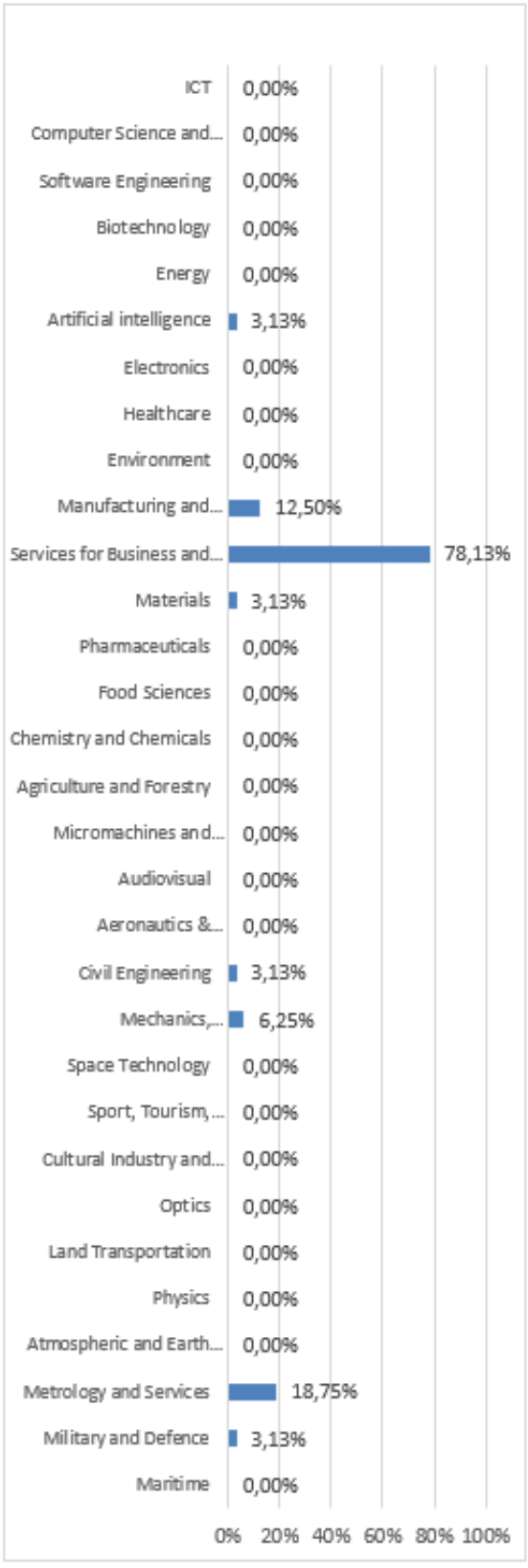

Figure 3b: Technology sectors found in ZalaZONE Park

In the following section, the activity-based classification of innovation ecosystems according to the Hungarian Unified Sectoral Classification System (TEÁOR) can be seen in *Figure 4*. The TEÁOR is the comparable version of the NACE code, it is referred to below as the NACE code for simplicity.

The sectoral distribution of ZalaZONE Park is illustrated in *Figure 5* based on the main activity of the settled companies of the ecosystem according to the NACE code.

Based on the results, it can be said that the most typical activity of the Park is code 72 (scientific and technological research and development), carried out by one third of the settled companies. The leasing and operation of owned and rented real estate as well as code 71 (engineering activities and technical consulting) are also decisive.

It can be seen that ZalaZONE Park mostly concerns the technical field with its technological focus linked to scientific research and development. This is confirmed by *Figure 3* since 78% of the technology sectors belong to the business and industrial services group, the main activity of 52% of which is scientific research and development with NACE code 72.

The sectoral groupings generated on the basis of the NACE codes used in Europe are shown in *Figure 6*. The essence of the classification is to create categories that take into account the NACE codes that show a more realistic picture of the sectoral character of ZalaZONE Park. For this reason, 9 classifications were established as shown in this figure.

Given that in the literature, grouping predominantly occurs according to technology focus, it can be said that the results of the data series are closer to those when grouping according to the technology focus than the breakdown by NACE codes.

According to this approach, business management and management consulting are the most widespread sectoral foci of the settled organizations at ZalaZONE Park, however, the automotive industry as well as research and development activities are also decisive, representing 65% of the focus areas in total.

In terms of technological focus, 9 different categories can be distinguished in relation to ZalaZONE Park. The most common category is business and industrial services, which can be considered in parallel with business management and management consulting illustrated in the previous diagram. In terms of technological focus, in addition to business and industrial services, metrology and related services are also actively present in the Park, which can be traced back to the goals of ZalaZONE Park.

Regarding the activity-based classification of innovation ecosystems, it can be stated that, based on the interpretation according to NACE, ZalaZONE Park is located in the lower left quadrant as shown in *Figure 1*, which means that the scope of activities is wide but defined professional directions are found. The resulting category and the interpretation according to the

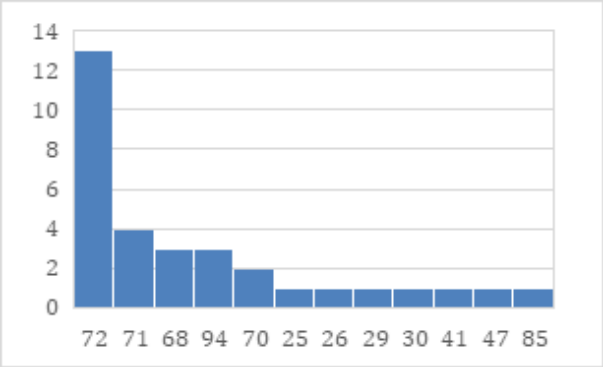

Figure 4: Sectoral distribution of ZalaZONE Park according to NACE codes

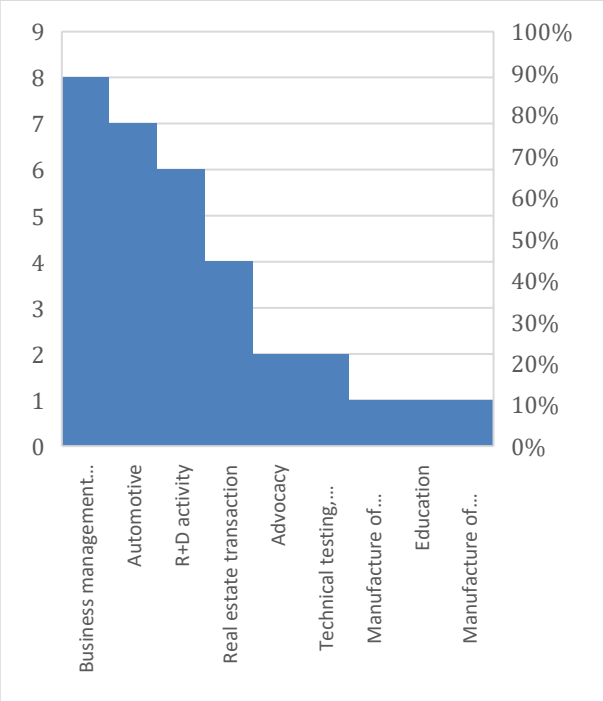

Figure 5: Sectoral distribution of ZalaZONE Park according to reasonable alternatives

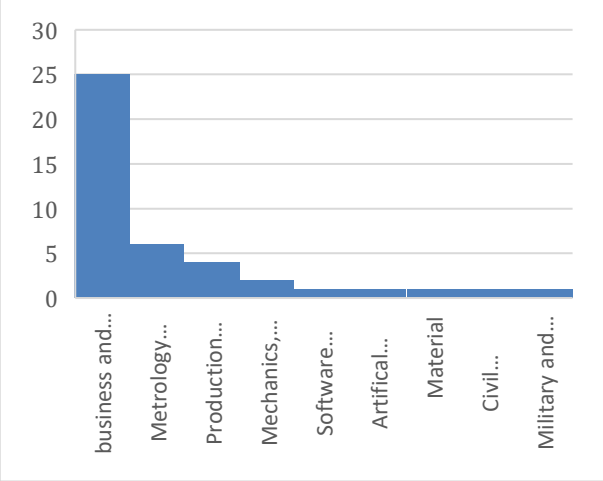

Figure 6: The technological focus of ZalaZONE Park

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF
A		0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	1	0	1	0	0	1	0	1	0	0	0	1	0	0	1	0
B			1	1	1	0	1	0	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0	1	1
C				1	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0
D					0	0	1	0	1	1	0	0	1	1	0	1	0	1	1	1	1	0	1	0	1	1	0	1	1	0	0	0
E						1	1	0	0	1	1	1	0	0	1	1	1	1	1	1	1	0	1	1	0	1	0	1	1	0	1	0
F							1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	1	0
G								0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0
H									0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0
I										1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	0	1	0
J											0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	1	0
K												1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1
L													0	0	1	0	1	1	1	1	0	0	0	1	1	0	0	1	0	0	0	0
M														1	1	0	1	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0
N															1	1	1	1	0	1	1	1	1	1	0	1	0	0	0	1	1	0
O																0	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	0
P																	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0
Q																		1	1	1	1	1	1	1	1	1	1	1	1	0	1	0
R																			0	1	1	1	1	1	1	0	0	1	1	1	0	0
S																				0	1	1	1	1	1	1	0	1	1	1	1	0
T																					1	1	1	1	1	1	0	1	0	1	1	0
U																						1	1	1	1	1	0	0	1	1	1	0
V																							0	1	0	0	0	1	0	0	0	0
W																								0	1	0	0	0	0	0	0	0
X																									1	1	0	1	0	0	1	0
Y																										1	0	0	1	0	1	0
Z																											0	0	0	1	0	0
AA																												0	0	0	0	0
AB																													1	0	1	1
AC																														1	1	1
AD																															0	1
AE																																0
AF																																

Figure 7: The cooperation matrix of ZalaZONE Park

technological focus, on the other hand, places the Park in the lower right quadrant, which presupposes a less diverse sectoral focus, implying the existence of professional directions.

Summarizing the previous three figures, it can be stated that the Park has a designated technological focus, but its technological diversity is moderately high.

The cooperation matrix of ZalaZONE Park is shown in *Figure 7*, with singular anonymous numbers representing the organizations between which some kind of cooperation can be named, highlighted with a yellow background color. Based on the matrix, it can be concluded that cooperation between the settled organizations is intensive with the goal of the Park attracting new actors into the ecosystem in the future. Its aim is also to bring together organizations that have not yet started cooperating with each other and encourage the development of mutual cooperation, not just one-way cooperation. The means of this are, among others, strengthening the relationship between the actors by generating various projects, organizing joint events within the Park and developing a common value system.

In addition to the previous figure, the network of contacts is illustrated by *Figure 8*, which confirms the presence of an active connection between the settled actors. The figure shows that for each organization (e.g. G, Q, J, T, U) thickenings can be seen, which indicate the cardinality of the relationships. Cooperation between the organizations, denoted by the letter codes AA and AF, and other actors is currently less but this may be due to the fact that recently established actors fall into this category.

Within science and technology parks, cooperation is particularly important as the resulting collaborations create knowledge transfer and exchange of experience which are indispensable factors to raise the collective level of knowledge, greatly contributing to the strengthening of regional development and corporate competitiveness. Therefore, the main task of park management is to encourage cooperation between the settled actors in the Park.

The companies denoted by the letters "G" and "Q" have established the most relationships with other organizations in the ecosystem according to *Figure 9*, comprising 27 connections, meaning that the most active organization at ZalaZONE Park is in contact with 84% of actors at the Park. Furthermore, it can be seen that the multitude of contacts of other organizations is also decisive.

The moderate gradient of the chart also illustrates that the median values fall above the arithmetic mean line, i.e. the gradient of the chart does not suddenly change. Based on this, it can be said that most actors strive to establish as many relationships with each other as possible. This is reinforced by the fact that 62% have more relationships with each other than on average and, these relationships are unidirectional or mutual. The

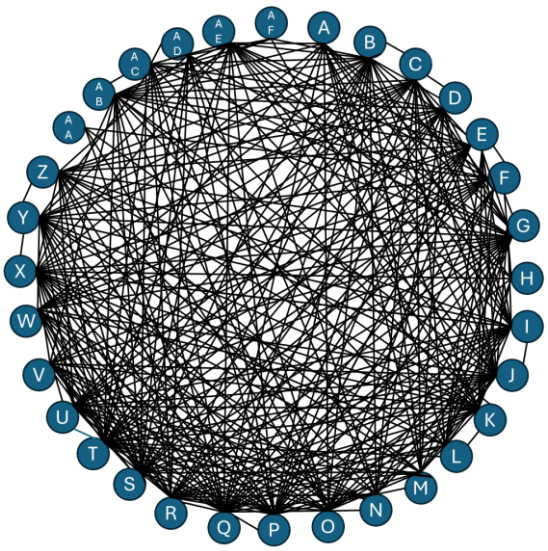

Figure 8: The network of connections at ZalaZONE Park

short-term goal is that a significant proportion of relationships should be bidirectional, thereby creating similarly large benefits for both parties.

4. Discussion

The main aim of this paper was to analyze the sectoral questions of science and technology parks through the case study of ZalaZONE Park.

Since the literature presents different types of innovation ecosystems with various characteristics, it is worth examining the activity characteristics as well which can be examined according to the sector of actors operating in the ecosystems as well as from the point of view of the technologies used.

Following the theoretical overview, the research introduced the activity-based classification method of innovation ecosystems, which foresees the definition of the sectoral character of ZalaZONE Park, the pillars of which are NACE codes, the sectoral focus generated from them and the technological focus.

In the first round, the public data from the IASP Global Survey 2022 and parameters of ZalaZONE Park were compared according to the manufacturing activity and technological focus. It was possible to conclude that the service portfolio of ZalaZONE Park integrates manufacturing activities similarly to international examples, moreover, its technological focus mainly addresses business and industrial services. This set includes scientific as well as research and development activities, business management, management consulting as well as real-estate transactions and advocacy.

According to different points of view, 12 different types of sectors are found according to NACE codes, while in the case of the version created on this basis and in terms of the technological focus, 9 categories are found in each. In the literature, grouping according to technological focus is prevalent, so the results of the data series formed more closely resemble grouping by technological focus than the breakdown by NACE codes.

In light of the above, it can be concluded that the sectoral focus of ZalaZONE Park according to NACE codes concerns scientific research and development, which is further clarified by the classification generated on the basis of these. The technological direction is focused on business and industrial services, which is closely related to the previous categories since 52% of business and industrial services are mainly engaged in scientific research and development (NACE code 72).

Regarding the activity-based classification of innovation ecosystems, it can be stated that, based on the interpretation according to NACE codes, although the scope of activities at ZalaZONE Park is wide, defined professional directions exist. However, the interpretation according to the technological focus supposes a less diverse sectoral focus, implying the existence of professional directions. It can be stated that the Park has a designated technological focus but its technological diversity is moderately high.

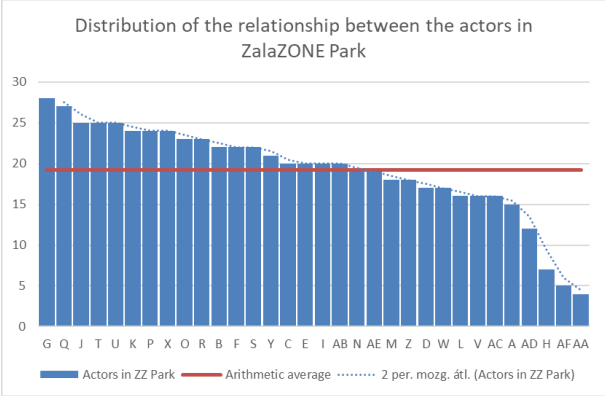

Figure 9: Distribution of relations between the settled actors at ZalaZONE Park

In light of the above, the research also touched upon cooperation between the actors settled at ZalaZONE Park, based on which it can be stated that the organizations actively cooperate with each other. Management at the Park encourages the development of such cooperation through various projects and events. Future goals include further expanding these relations and making them reciprocal in one-way relationships.

The results confirm the main research question, namely that the sectoral nature of science parks can be examined on the basis of various aspects, based on which classification according to technological focus provides a real picture of the nature of the ecosystem. It can also be assumed that parks with a technological orientation are more likely to build relationships between actors.

Although the research focused on the ZalaZONE Park, the methodology can be applied to the analysis of other parks and innovation ecosystems, which could be a subject of further research.

5. Conclusions

Overall, since it can be stated that the NACE classification is not always clear, this study confirms the analytical method of other research because classifying according to the technological focus can provide a better picture of the activities of the organization.

Furthermore, it can also be concluded that similarities are observed between the sectoral classification and technological focus based on international examples. A unit difference can be identified in terms of the cardinality of the categories according to this interpretation, moreover, classifying according to the activity undertaken in this way yields the same result. This classification positions ZalaZONE Park as sector-focused but lacking technological diversity. This statement represents its actual status and serves as a signal for the development of technological diversity, thereby increasing the ability to respond to rapidly changing market conditions.

By harmonizing the three different approaches, ZalaZONE Park is an innovation ecosystem with a

medium degree of diversity and an outlying sector which can be developed by integrating new sectors.

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https://www.iasp.ws/our-industry/knowledge-room/iasp-global-survey-2022--science-and technology-parks-and-areas-of-innovation-throughout-the-world

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