**GLOBAL ACADEMIC RESEARCH INSTITUTE**

COLOMBO, SRI LANKA


**GARI International Journal of Multidisciplinary Research**

ISSN 2659-2193

**Volume: 10 | Issue: 04**

On 31st December 2024

http://www.research.lk

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GARI Publisher | IT | Volume: 10 | Issue: 04

Article ID: IN/GARI/ICISMT/NOV/2024/120 | Pages: 67-84 (18)

ISSN 2659-2193 | Edit: GARI Editorial Team

Received: 04.10.2024 | Publish: 31.12.2024

# PRESENCE OF UNIVERSITIES AT SCIENCE AND TECHNOLOGY PARKS

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## *ABSTRACT*

Universities are key players of science and technology parks. Their contribution to innovation, research and development, start-up initiatives and high-added value competences is significant. Presence of universities at science and technology parks, either directly or indirectly, is essential. The current research aims to analyse the presence of universities at the beginnings and currently at science and technology parks. As a base professional background, the triple helix model is used to define the assessment model. After the literature review, the paper presents the results of a research on 95 European science and technology parks. After a descriptive overview, the study examines the presence of universities at science and technology parks from two aspects. First, the presence of universities is analysed as a founder of the parks, whether as full owner or partial participant. Secondly, the current presence of the universities is assessed taking into account the type of the park. Based on the analysis, role of universities in founding circumstance and the actual park type is discussed. At conclusion, it is pointed out what kind of roles are taken by the universities both at establishment and operation of science and technology parks. As an empiric example, the ZalaZONE Technology Park in Hungary is shown to illustrate the various opportunities for presence of universities at a park.

Key words: technological innovation, ecosystem development, science park, long-term competitiveness

## *INTRODUCTION*

Examining the relationship between science parks and universities is of paramount importance for innovation and the development of the knowledge-based economy. Innovation is one of the key drivers of the modern economy, which fundamentally determines competitiveness and the growth of social welfare. Cooperation between universities and science parks is particularly important as they can integrate the latest results of research, development and education into practice. Knowledge and research results generated by science parks can contribute directly to industrial innovation, the development of new technologies and economic growth. The relationship between universities and science parks is not only achieved through joint research projects and technology transfer but is also of importance for attracting and retaining talent. The involvement of university students and graduates in research and development activities provides an opportunity to integrate the latest knowledge and innovative ideas, and is also meaningful on a societal level, as it facilitates the integration of new employees into the market environment.

Digitalisation and innovation processes have created new challenges and opportunities for cooperation between science parks and universities, highlighting that rapid adaptability and resilient innovation ecosystems are key to maintaining economic and social stability. The success of cooperation between universities and science parks depends

mostly on effective relationship management and proper management of value creation processes. The organisation of workshops and conferences, the use of common infrastructure and laboratories, and strategic agreements all contribute to increasing knowledge sharing and innovation capacity. Through such cooperation, the relationship between universities and science parks not only promotes technological development but also provides economic benefits for both parties. The study aims to provide a comprehensive overview of the various aspects of collaboration, with particular reference to geography and the circle of founders, which are particularly decisive when outlining the development arc of a science park.

The aim of the study is to analyse the university's presence in the structure of science parks and their operation. Based on domestic experience and national examples, there has been a significant change in the number of industry-university collaborations under the Triple Helix model compared to the last decade. Business and academia have discovered the benefits of collaboration and are seeking to capture a significant share of these benefits by developing joint projects. As most universities have a long history, they are able to transfer a high level of knowledge through cooperation, the importance of which is recognised by industry, i.e. the role of universities in science parks is crucial. In this respect, the study assumes that the presence of universities influences the development of the science park, the number and quality of the organisations that move in. The study assumes that the presence of universities will enable science parks to better manage knowledge transfer and the flow of technologies and industrial innovations.

## *LITERATURE REVIEW*

During the literature review, the development of science parks and the cooperation between parks and universities will be presented, emphasizing the importance of the academic sphere, as well as the obstacles to this cooperation, and finally the internationalization of universities and the characteristics of university research parks will be discussed. In the first part, the development trajectory of science parks was detailed. The concept of science parks dates back to the mid-50s, according to some sources, it can be linked to strategic considerations in North Carolina. The main obstacle to new approaches to linking university and industry was the limited availability of financial capital, facilitated by the involvement of financial partners. This was followed by the establishment of Research Triangle Park, an approach that Europe integrated in the early 70s, and the International Association of Science Parks was founded in 1984, when the role of science parks in promoting socio-economic development was recognized. As a result, European policies have also evolved in response to changing paradigms and similar policy and funding opportunities have been introduced to support this paradigm shift.

Based on this, the Triple Helix model could also be interpreted in a new concept:

- The ability to retain talent,
- Networking,
- Acceleration capacity,
- Marketization (Pascoal & do Rosário Cabrita, 2016)

The change in science parks is confirmed by a study that comprehensively evaluates the effectiveness of Science and Technology Parks (STPs) based on 221 articles published in the period 1987-2021, paying particular attention to quantitative analysis of the effects of parks. According to the results, the probability of positive effects increases significantly with increasing sample size. The involvement of universities in a science park has a major impact on its innovation activity, which can be measured, for example, by the sale

of new products and the number of patent applications filed. For this reason, the following types of parks were distinguished:

• Clean science parks, where the university is the main shareholder,

• Mixed parks in which the university is a minority shareholder,

• Technology parks with university presence, in which the university does not have a stake, but some university research facilities are located in the park,

• Clean technology parks in which the university does not participate. (Albahari, et al., 2022)

The results of innovation performance show a clear consistency between park types, with clean science parks having the highest patent performance. (Albahari, et al., 2017). This is confirmed by the analysis that companies operating in science parks cooperate more closely with universities, which improves their productivity, market position and innovation activities. Companies that cooperate with education are also more advanced in terms of market share, quality of products and services and cost competitiveness. Companies operating under the auspices of a science park carry out more research and development due to the closer relationship with the local university, as they exploit the surplus knowledge generated by the university. (Malairaja & Zawdie, 2008). However, building relationships with universities is nuanced by their role in the regional innovation ecosystem, according to which universities' behavioural strategies can be categorized into three groups: active, passive and neutral. The general goal of science parks is to involve universities, encourage active participation, thus achieving the most beneficial cooperation. (Akberdina & Vasilenko, 2022)

In addition to university involvement, creating a sustainable economy is also a priority area, and policymakers encourage technology-based companies to coexist under the auspices of a science park, thus exploiting innovation benefits. For companies, the presence of the following factors helps to settle in the science park:

• University presence,

• Joint business support,

• Proximity to recreational facilities,

• Advantageous geographical location, including proximity to a railway station.

The companies in the park are most willing to pay for the proximity of the university, followed by the R+D facilities provided, the accessibility of the site, the provided common facilities, the technological focus of the area, and finally the events held in the area. (Ng, et al., 2022). In many cases, the size of the enterprise also plays a role in the choice of location between university and non-university science parks, smaller companies prefer to settle into an ecosystem where a higher education institution is actively present.

The reason for this choice lies in achieving a high level of corporate innovation, in which universities are key players and knowledge that is needed by a smaller, less networked company. Firms cooperating with universities are understood by the market as more stable and have stronger internal capabilities, while companies cooperating with technology institutes are smaller and rely more on external sources. Universities support more advanced companies, while technology institutes help companies in need of assistance in innovation processes. Several studies therefore confirm the cardinal role of universities in regional innovation development, as they influence the innovation results of neighbouring companies, especially small and medium-sized enterprises. In addition, account should be taken of the constraints which make it difficult to achieve this cooperation. These factors include communication difficulties and a shortage of highly skilled workers in the industrial sector. On the academic side, the lack of availability of state incentives also appears

as a complicating factor. (Barge-Gil, et al., 2011)

Overall, successful cooperation requires universities to develop their technological capabilities to find more common ground with the industrial sector, and industry needs to be open and proactive to such collaboration, the generation of which can be made even more effective by the public sector through various subsidies. However, education, research and community engagement cannot be separated, as they can serve both economic and social missions. The new model, which involves the integration of multidextrous universities, proposes that universities apply a local approach in all their activities in order to make a successful regional contribution, thereby stimulating the economy to innovate. The concept of multidextrous, i.e. diverse universities, is a mix of universities committed to entrepreneurial and social development, capable of effectively promoting regional development. This type of university strives to maintain a balance, therefore it must focus on the application of research for industrial purposes and social commitment at the same time, carrying out all these activities taking into account local culture, values, innovation habits and involving regional actors in the operation, since it provides value to both industry and the local community through its services. Based on these conclusions, it can be stated that universities should be decisive players in regional development, which can be achieved through the concept described above and adaptation to the changing environment. (Thomas, et al., 2023)

A particular example of university collaboration is the three universities in Porto Alegre, Brazil, which work together to manage a network in competition, which promotes knowledge mobility, innovation and network stability. The results show that universities' leadership enables them to initiate collective actions and projects and delegate responsibility to other network actors, thereby creating benefits for the whole region. Based on the case example of universities located here, it can be stated that universities, especially in developing economies, are the cornerstones of creating an innovation ecosystem, and due to their credibility and reliability, they build relationships with local actors more easily than other members of the Triple Helix model, thus they have a great influence not only in sharing knowledge, but also in coordinating the innovation ecosystem. The resulting innovation results can bring benefits not only to the university and companies, but also to the entire region, so this study confirms what has been said earlier that the active role of universities is necessary for the creation of an innovation ecosystem, in which the reputation of the participating university plays a decisive role. (Thomas, et al., 2019). The following study examines the motivation of university presence, as universities have no obligation whatsoever in this regard, and internationalization pressures also make cooperation difficult. Effective regional cooperation between universities requires understanding four aspects:

- Labour market development,
- The contribution of world-class academics to regional innovation networks,
- Directing universities to regional engagement of academics,
- Increasing the quality of regional innovation strategic processes.

The role of universities in regional development is made up of various factors, as they nurture professional backgrounds, employ many university graduates, actively cooperate with industry and influence policymaking. However, university-industry cooperation comes with challenges. The studies highlight tensions and obstacles that may limit universities' regional engagement. These include, among others, the gap between graduates and the labour market, conflicts of interest between universities and

companies, and different institutional logics between universities and regional governments. To counteract this, universities and industry alike must be sympathetic to each other's interests and work together towards a common goal, namely regional development. However, for this to happen, actors must be able to adapt to changing regional circumstances and different interests. (Benneworth & Dahl Fitja, 2019)

The research excellence of nearby universities plays a key role in the success of science parks, which is an indispensable source of knowledge for industry. The research showed that universities with smaller research capacities are less able to participate effectively in collaborations. It also stresses that close cooperation with universities can lead not only to scientific results, but also to regional economic development. (Minguillo, 2014). Cooperation between science parks and universities contributes significantly to increasing innovation capacity. According to the study, sustainable innovation requires new models that integrate stakeholder needs. It also highlights that proximity to universities supports technology transfer and promotes regional economic growth. (Narasimhalu, 2015). The scientific knowledge provided by universities in Spanish science parks plays a significant role in the technological development of companies that rent parks. According to the research, universities' exploratory strategies positively influence patent activity, while marketing research is less effective. The results highlight the close link between university strategies and innovation performance. (Villasalero, 2014)

Science parks' talent attraction strategies are closely linked to the success of parks and their tenants. Research emphasizes that engaging the best students and alumni is key to innovation. Formal and informal partnerships with universities promote not only innovation but also sustainable development. (Löften, 2020). The basis for the development of science and technology parks is effective cooperation with universities. The integration of autonomous systems and data-driven services will help bring innovation to market faster. The research also highlights that multi-stakeholder models play a significant role in the long-term success of parks. (Makhdoom, 2016). Cooperation between academia and industry is essential for science parks to succeed. Public-private partnerships provide an effective framework for fostering innovation while supporting economic growth. The research highlights that these links not only strengthen the viability of new businesses but also contribute to tackling social problems such as unemployment. (Chanakira, 2014)

Based on the article by Barge-Gil, Santamaría and Modrego (2011), it can be stated that the complementary roles between universities and technological institutes in supporting innovation activities are implemented in different ways. Universities support larger companies with strong internal capabilities, while technology institutes support innovation processes for smaller companies that rely on external connections. (Barge-Gil, 2011). Fernandes et al. (2023) found that university-industry R+D collaborations are key to creating innovations, but often face obstacles, for example due to lack of trust or the achievement of strategic goals. The presence of universities plays an essential role in increasing the innovation capacity of the industry. (Fernandes, 2023). The work of Glittová and Sipikal (2022) reveals that university science parks in Slovakia are tools created to support innovation and facilitate cooperation between universities, industry and government. At the same time, sustainability and lack of long-term financing hamper their effectiveness. According to research, the presence of universities plays a key role in developing

research infrastructure and implementing innovations in regions. (Glittová, 2022)

According to Thomas et al. (2020), universities play a significant role in developing regional innovation ecosystems, especially in emerging economies. The authors noted that universities, as leaders, coordinate cooperation between local actors, creating stable networks and wider knowledge sharing. Using an example from Brazil, they demonstrate how the joint efforts of universities contribute to the development of the region. (Thomas, 2020). According to Hewitt-Dundas et al. (2020), university-business cooperation can bring significant innovation benefits, although different goals may create barriers. The authors found that experience gained from previous collaborations improves businesses' ability to manage university partnerships, especially for smaller firms. Such learning effects foster innovation success and long-term relationships. (Hewitt-Dundas, 2020). The overall conclusion of the literature review is that the presence of universities can make a major contribution to the success of science parks, as this type of cooperation increases the innovation capacity of the parties and also stimulates the competitiveness of the economy. It also has a positive impact on the quantity and quality of R&D activities and the process of knowledge sharing. These considerations underpin both the relevance of the topic and the justification of the research questions, which are confirmed by the literature review.

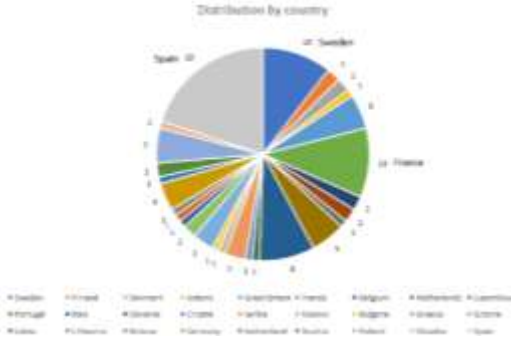
## *METHODOLOGY*

The present research is the result of a data processing of 95 science and technology parks in Europe, based on publicly available data and information, also based on public sources of the IASP (International Association for Science Parks and Areas for Innovation). The basic database groups the 95 science parks surveyed by country, examines the number of participants in each park, the nature of the park and the founders of the park. The aim of the present study is to answer the question of the form and role of universities in science and technology parks, and for this purpose it evaluates the nature of science parks and the circle of founders. Thus, the main focus of the research is on university parks and parks established by universities, which are the main focus of the study. During qualitative evaluation, with the help of a chart analysis, the research examines the distribution of science parks participating in the data collection by country, the distribution by circle of founders, focusing on science parks and innovation ecosystems whose founder is a university, studies the nature of different science parks, and outlines the relationship between the founder of the science park and the nature of the park. Finally, as a quantitative part of the research, the analysis outlines the relationships between the founders' circle and the nature of the park with the methodology of cross-tabulation analysis. This part of the data was summarized using the JAMOVI statistical data analysis software, thus revealing possible relationships between the various attributes. During the crosstab analysis, the Fisher exact test was carried out, on the basis of which conclusions were formulated.

The methodology described here provides an opportunity for other science parks and innovation areas to examine the relationship between their own park's founding body and the nature and structural changes of the park. The research also encourages management to make this link not only with the science park under their management, but also with the parks they are associated with, thus drawing profound conclusions that will inform the park's development curve. The proposed methodology is a cross tabulation analysis using statistical software.

## *DATA ANALYSIS*

Distribution of science parks by country



*1. Figure - Distribution of science parks by country*

*Source: own editing*

The following is a breakdown by country of the research science and technology parks selected on a representative basis. Based on the selected sample (Figure 1), it can be seen that Spain selected the most science and technology parks, 19th in total. This is followed by France and Sweden with 10 science parks each, Italy with 8 parks and Portugal with 5. Based on the data of these parks available on the Internet, the following conclusions have been determined.

**Founders of Science Parks**

*2. Figure - Analysis of nine types of science parks by circle of founders*

*Source: own editing*

With the country overview (Figure 2), in addition to the numerical nature of science parks, their characteristics and diversity are also decisive. The fact that a country has several science parks does not necessarily mean that these parks operate in a homogeneous manner. The goals, areas of operation and founder structure of science parks can vary greatly. The circle of founders, be they private companies, public bodies or universities, have a significant impact on the achievements and development arc of parks. The figure clearly illustrates that the circle of founders who are purely university or university and other organizations is the most typical in the case of the science parks examined, since nearly half of the sampled founders, 46.31%, have a university-related circle of founders. In 14.73% of cases, we are talking about pure university ownership, which confirms the assumptions established during the literature outlook that the role of the university in the development of science parks is decisive.

Spanish parks cover a wide spectrum both in terms of their circle of founders and areas of focus. This means that the science parks studied serve many different industries and innovation areas, creating a complex, multifaceted innovation ecosystem. As a result, although Spain is already a leader in terms of the number of science parks, the impact and operational objectives of these parks can also vary widely, which can give the country a significant competitive advantage in innovation and technological development. Thus, in addition to analysing the number of science parks, it is worth considering their complexity, focus areas and founding structure, as these will certainly have a significant impact on the innovation capabilities and economic development of the given country. A more detailed analysis of

Figure 2 shows the composition of the founders of the surveyed European Science Parks, broken down into nine categories. These categories include different actors and largely determine the nature of each park. Different founding structures can be observed in different countries, which have a direct impact on the type of innovation activities that take place in the respective science parks.

• Foundations: Foundation involvement is relatively modest in the overall chart, with little or no founder representation in many countries. Parks founded by foundations are generally nonprofit in nature and focus on research and development as well as social utility. They have some presence in countries such as Germany or Italy, where special attention is paid to innovation and social values.

• Private companies: The private sector is a major player in the establishment of science parks, especially in Switzerland, where the number of private founders is extremely high. This trend indicates that industrial and technological innovation and economic exploitation are among the primary objectives of science parks in Switzerland. In addition to Switzerland, private founders are present in several other countries, but not to such a dominant extent. The privately established parks primarily serve competitive technological developments as well as the needs of industry and follow market-based operation.

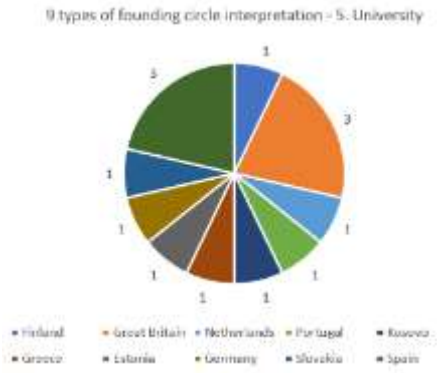
• Local governments: The role of local governments as founders is also decisive, especially in countries where promoting local economic development and regional innovation is a priority. Italy, France and Portugal are countries where local authorities play a significant role. These parks focus primarily on economic recovery of local communities and regional development goals, often in close cooperation with local government.

• Public institutions: Parks established by public institutions are present in several countries, such as Germany, France, Spain and Greece. The aim of state-founded parks is usually to strengthen international competitiveness, support priority research and development investments, and develop the national innovation ecosystem. These parks are important players in countries' innovation strategies, as they support the development and application of new technologies with public resources.

• Universities: The presence of university-founded science parks can be observed in several countries, although often in smaller numbers. For example, Great Britain, Finland and Spain have several university-based parks in the sample. These parks focus primarily on education, research and knowledge transfer activities of universities, helping to apply scientific results in practice and develop the innovation skills of students and researchers.

• Co-establishment of public and private institutions: The combination of public and private cooperation is also emerging in some countries. In this type of park, public and private interests meet, allowing a combination of private sector dynamism and stability provided by public support. These parks can respond flexibly to both business and public policy goals, such as national innovation priorities or stimulating economic growth.

• Co-founding of municipalities, private companies and universities: This triple cooperation also plays a significant role in certain countries where parks integrate different purposes. This cooperation model makes it possible to align local communities, market needs and R&D objectives, often by promoting sustainable economic development and local job creation. These types of parks are usually typical examples of the Triple Helix model.




*3. figure - 9 types of founding circle interpretation - University*

*Source: own editing*

Figure 3 focuses on purely university-based science parks, thus highlight the role of higher education institutions in the present analysis. Through their specific objectives, these parks serve scientific development and innovation. Parks founded by universities play a prominent role in the innovation ecosystem as they provide a direct link between academia and industry. Such parks support the market application of research results and the economic utilization of university knowledge.

However, the distribution of university parks varies between countries:

• Great Britain and Portugal: There are several university parks in these countries, indicating that university research and industrial cooperation are given priority.

• Spain and Finland: The number of university-based parks is also higher, suggesting that universities are important players in national innovation systems.

• Germany, Estonia, Kosovo and Slovakia: These countries have fewer university-based parks, but these institutions still have a major impact on local innovation processes.

The goals of university-founded parks are mostly to promote research and development, education and the application of new technologies. Such parks contribute to the training of young researchers, entrepreneurs and innovators and to the commercialisation of technological and scientific results. Knowledge transfer is characteristic of this type of park, which makes it possible to exploit the economic potential of university research. Overall, the analysed charts, based on a survey of 95 European science and technology parks, show that the founders of European science parks are diverse, and that this diversity directly influences their functioning, goals and directions. There are significant differences between the types of founders that determine what focus areas parks concentrate on: while private companies pursue market goals, university-founded parks concern more on research and innovation. State and municipal parks are aligned with public policy goals, such as regional development and increasing international competitiveness.

The different founding structures in different countries suggest that science parks need to adapt not only to local economic and scientific needs, but also to national and international development priorities. The diversity of the parks' operational profiles contributes to increasing Europe's scientific and innovation potential and strengthens cooperation between research and industry actors. The following is a discussion of the theory of the triple helix model, which appears as an intense factor influencing the nature of science parks. The concept of the Triple Helix innovation model was developed by Etzkowitz and Leydesdorff in the mid-90s (1996). The model is based on the fact that the potential for innovation and economic development in a knowledge-based economy and society lies on the one hand in the transformed role of higher education institutions and academia. On the other hand, higher education is a dynamic system of relations between economic actors and government,

which creates new institutional and social forms, facilitating the creation, transfer and application of knowledge and innovation. In analyzing the evolution of the Triple Helix model, Etzkowitz and Leydesdorff (2000) also identified two earlier models: the strong state model and the "laissez-faire" model. The strong state model was typically dominant in Central and Eastern Europe and post-Soviet countries, while the laissez-faire type was more based on corporate dominance and spread in countries such as Sweden or the United States. The authors hypothesize that these models are evolutionarily linked: initial state dominance gradually transforms into partnership until cooperation between the three spheres reaches an integral form of Triple Helix. This model means cooperation in which participants work together, preserving their own goals, but integrating along common interests. In the interactive Triple Helix model, establishing a relationship of trust and partnership between the three spheres - state, industry and academia - is the most important goal, leading to long-term cooperation. The participants play several roles at the same time and follow a kind of "coopetition" strategy in the innovation process, where competition and cooperation are also present. This model is particularly prevalent in the most innovative European countries, where the success of projects is determined by the quality of cooperation. Case studies, such as those from Sweden or Denmark, highlight that the key to success is joint advocacy among participants and the selection of appropriate leaders who are proficient in both the public and private sectors. (Horváth, 2021).

**Nature of science parks**

*4. Figure - Nature of different parks*
*Source: own editing*

Figure 4 shows different types of nature of science parks. Each type was identified based on related literature sources, along typical innovation ecosystems. Reviewing each park's website, the descriptions and information contained therein have been categorized into five categories:

- Technology Park
- Business Park,
- University Park,
- Innovation Hub,
- Science Park (Remark: The Classic, triple-helix-based interpretation)

Science and innovation parks around the world have different characteristics, which are greatly influenced by their founders and the innovation ecosystem of each country. The diagram clearly shows that different types of parks have developed in different countries, the goals and actors of which differ from each other. The importance of founders, especially the role of foundations, is rather modest, while other organisations such as universities, research institutes and state actors have a much greater influence on innovation activities.

Figure 4 shows the nature of each Science and Innovation Park by country. Different parks have different innovation roles, which are detailed below.

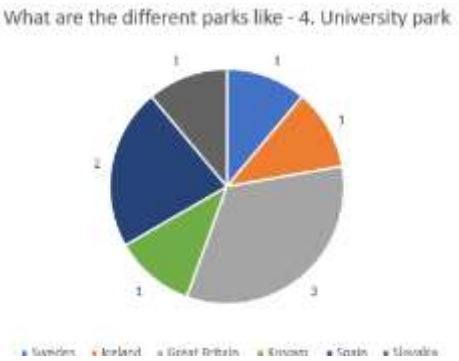
• Technology Parks: The main purpose of technology parks is to promote technological innovation. Such parks are often based on private and public partnerships, with a strong focus on IT, biotechnology and energy developments. Spain is the leader in technology parks with a share of 4.2%. Countries such as Germany, France and Greece also play a significant role, with a distribution ranging from 1.1% to 2.1% in the sample examined. Central elements of technology parks include incubators and accelerator programs aimed at supporting startups and promoting market application. The founders are often universities and public research institutes that support the commercialization of research results.

• Science parks: Science parks marked in green are in direct contact with universities and research institutes. The main task of these parks is to promote research and development and the economic application of scientific results. Based on the sample group of the study, Spain is dominant here (4.2%), but Germany, Sweden and Austria also operate significant science parks. One of the main features of science parks is the presence of multidisciplinary research centres working in close cooperation with local industry. These parks often focus on sectors such as medicine, chemicals, and energy science.

• Business parks: Business parks are primarily designed to support entrepreneurship and business innovation. Spain also stands out in this area, with a share of 7.4%, while other countries such as Italy (2.1%) and Sweden (2.1%) have a lower share in the sample examined. Business parks focus more on industrial and technological enterprises and provide an excellent environment for startups and SMEs. Parks often have incubator programmes and funding opportunities created through public-private partnerships.

• University Parks: University parks operate with the direct involvement of universities and research institutes, where scientific research and industrial applications are intertwined. France plays a prominent role in the sample examined, with a share of 8.4%. Other countries, such as Italy and Spain, are also major players. University parks create an environment where academic research can directly lead to innovative products and services. These parks play a key role in technology transfer and close cooperation between universities and industry.

• Innovation Hubs: Innovation Hubs are hubs designed to embrace the latest technologies and ideas. Multidisciplinary collaborations play a particularly important role in such parks. Italy, Estonia, Portugal and other smaller countries are relatively evenly distributed in the sample for innovation hubs (2.1%).




*5. Figure - What are the different parks like – University Park*

*Source: own editing*

The diagram in Figure 5 shows university parks in six different countries, highlighting their distribution. University parks are particularly important in knowledge-based societies because they link academic research with industrial development.

• Sweden: Two typical university parks from Sweden are included in the sample group of research, which work closely with the country's universities, especially in the fields of technology and engineering. In such parks, cooperation

between the private and public sectors is emphasized, especially in the fields of ICT (information and communication technology), biotechnology and renewable energy research. University parks often include incubators where startups can benefit from university research, mentoring and funding opportunities. Sweden's strong innovation culture and the interconnectedness of university parks allow research to often become quickly marketable products, making it one of the country's main economic engines. These parks support the maintenance of the innovation ecosystem and are particularly important for industrial research and development.

• Iceland: Iceland's university park is relatively small, but this does not detract from the importance of the park. Science and innovation activities are often related to environmental protection, renewable energy sources and biotechnology, in particular because of the specific geographical and environmental conditions of the island country. The University Park of Iceland strives to maintain research projects aimed at developing sustainable technologies and solutions in close cooperation with universities. The Icelandic University Park is strongly linked to the country's small but dynamic research community, one of whose main goals is to find answers to environmental challenges.

• Britain: Three different university parks from Great Britain were included in the analysis, all of which are leaders in scientific research and industrial innovation. University parks play a key role in the industrial application of research results, especially in engineering, medicine and engineering. University parks have become venues where companies can access the latest scientific developments and research and build direct contact with actors in academia. In Britain, university parks also often serve as business incubators and encourage the development of technology businesses. For startups, these parks offer excellent opportunities for mentoring, R&D support, and engaging venture capitalists and investors.

• Kosovo: Kosovo's university park is more regional in nature but plays a decisive role in the country's scientific and economic development. Such parks aim to combine academic research with local industrial and technological enterprises, thus supporting the region's innovation potential. The park primarily provides local businesses with access to the latest research, technological solutions and infrastructure provided by universities. It plays an important role in promoting economic development and supports local small and medium-sized enterprises, especially in the technology and engineering sectors.

• Slovakia: The university park examined in Slovakia, like Kosovo, also primarily aims to promote local and regional economic development. The park focuses primarily on technological and industrial research and has close links with local institutions and research institutes. These types of parks allow for the rapid implementation of knowledge and technology transfer, which facilitates the practical application of research results and contributes to the competitiveness of local enterprises.

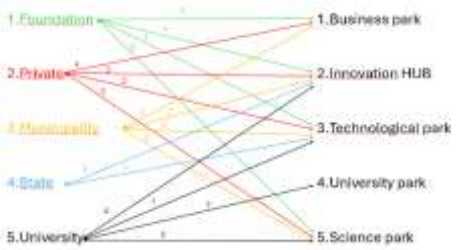
• Spain: Spain's university park is particularly important in the field of technology transfer, where university research results are directly used in industry and business. The park emphasizes cooperation between companies and universities, promoting the development of marketable technologies and innovations. These types of parks are important innovation centres that generate economic growth and serve the development of the knowledge-based society.

Based on the analysis of university parks, it can be clearly seen that these institutions play an extremely important role in innovation ecosystems. Parks

supported by universities not only provide infrastructure and professional support for scientific research but also facilitate the efficient application of research results to the market. University parks also create a favourable environment for startups and technology ventures and promote the rapid spread of innovation. Countries place different emphasis on the role and functioning of university parks. While university parks in countries such as Great Britain and Sweden have strong innovation and industrial links, in smaller countries such as Kosovo and Slovakia, these parks are more regional but also play an important role in the innovation development of the respective countries.

**Analysis of the comparison of founders' background and operational characteristics**

Figure 6 gives a joint overview of the relationship between the founders and nature of the studied science and technology parks. In the figure, the lines refer to the connection found, and the numbers indicated indicate the number of parks with such a connection found in the sample. The category on the left shows the founders' background of the parks in the sample studied, which can significantly influence the operational goals and directions of the parks. University-founded parks typically pursue research and educational purposes, while privately established parks may be more profit-oriented. The categories on the right of the figure characterize the focus of park activity. A narrower, specialized-focused park may better fit a specific industry need, while a park with a broader focus may provide opportunities for a variety of industries. This comparison suggests that the different founders' backgrounds and operational focus of parks jointly determine their operational nature. Parks that are university-founded and have a narrow focus are likely to have a deeper connection to academic research, while parks established by private companies with a broader focus may be more likely to seek to serve a wider range of market needs.




*6. Figure - Connection diagram*
*Source: own editing*

In the relationship diagram, you can see in detail the relationships between different types of pure ownership and parks. The figure clearly shows different patterns of different connections between parks and owners, the diversity and intensity of which are indicated by the number of lines and the frequency number. For example, there is only one relationship between the founders of the foundation and the business park, which shows that these owners are less interested in business parks. Similarly, in the case of the innovation hub and the technology parks, a connection can be seen to the ownership background of the foundation. At the same time, the research did not find direct connections with university parks, but three connections were established with science parks, which mainly serve research and development purposes.

In the case of the private sector, multiple interconnections can be observed, showing a wider spectrum of business interests. There are four links with business parks, which logically indicates the dominance of business interests in this category. The analysis revealed three relationships with innovation hubs and two relationships with technology parks. Interestingly, however, the private sector does not have a direct relationship with university parks, while science parks have two common

links, suggesting that the private sector is also involved in supporting scientific development.

The state/government is active in several areas. The analysis shows three links with business parks, reflecting the role of government actors in the development of business and economic parks. However, innovation hubs are particularly highlighted, as they show seven connections, which is the highest ratio among all ownership relations. Three connections appear to be with technology parks, but the study did not show a direct connection with university parks, while science parks have two common connections. In the case of the state circle of founders, relations are more moderate, although they are still present in several different parks. Interestingly, they have no connection to business parks, but they have three links to innovation hubs, which may refer to state innovation subsidies. There is only one connection to technology parks, but no direct connection to university and science parks.

The University is especially active in various categories of parks. They have one relationship with technology parks, and an outstanding number of seven connections to university parks appear, which makes sense since these parks primarily serve university purposes. They also have two common relationships with science parks, which refers to the research activities of universities.

**Crosstab analysis**

Range of park character

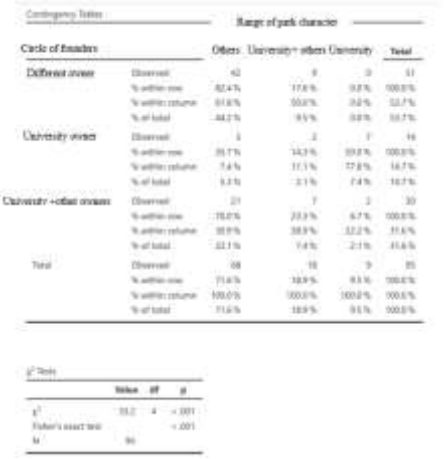


*Figure 7 - Crosstab analysis*
*Source: own editing*

During the crosstab analysis, the relationship between the founders of the science park and the nature of the park was analysed, based on the frequency table shown in Figure 7. Since the p-value is less than one thousandth because of the Fisher exact test, it can be said that a significant relationship can be established between the two attributes. The specifics of this relationship are described below. Based on the data, it can be stated that a significant proportion of science parks related to university owners are closely related to parks related to universities. About 46.3% of university owners are in direct contact with parks whose primary purpose is to support university activities, so it is clear that these owners are mostly focused on academic goals and education and research and development. The operation of these parks is strongly intertwined with the scientific work carried out by universities, which promotes the practical application of new technologies and knowledge.

In particular, the parks owned by universities serve university purposes to a very large extent. This peculiarity is not so clear in the case of parks with other ownership backgrounds. Of the 14 parks

owned by university owners, 7 reflect a fully university presence, meaning that 50% of university-owned parks are reserved specifically for university purposes. This ratio is outstanding and reflects the clear priority of university owners in supporting academic activities. These parks are typically associated with research universities, higher education institutions or science centres and their primary objective is to promote innovation and R&D through education and knowledge sharing. The total number of parks jointly owned by university and other owners is 30, which is 31.6% of the science parks participating in the research. This indicates that cooperation between different types of owners also plays a significant role in the operation of science parks. Among them are 7 parks jointly owned by university and non-university owners, suggesting that these parks are multifunctional in nature and suitable for a wider range of activities, such as industrial and academia. For these parks, different activities are carried out that combine university research and meeting market needs, allowing collaboration between different sectors. This type of cooperation promotes the practical application of scientific results, since both parties (universities and companies) can contribute to the operation of parks.

Furthermore, we found two parks that are also owned by university and other types of owners, but still, they are entirely for university purposes. This shows that even among mixed-ownership parks, they sometimes support academic purposes almost exclusively, although these parks are in the minority. In this type of park, universities typically dominate the operating model, and the emphasis is on research and education, even if other types of owners are involved. Overall, non-university-owned and character parks often serve business or industrial purposes, however, 9 of them also have academic or research functions, suggesting that these parks are not focused on purely economic purposes, but are also connected in some way to university activities. This type of multifunctionality provides opportunities for knowledge sharing and joint innovation between universities and the private sector. Overall, the data shows that 44 of the 95 parks are connected to universities in some way, which is nearly half of the parks. This ratio shows that universities play an important role in the functioning of science and technology parks, especially in research and development. University owners primarily own their own university-owned parks and have less interest in other types of parks or mixed-ownership facilities. At the same time, in the case of mixed-ownership parks, cooperation between universities and other owners is observed, which allows parks to multifunction and achieve broader goals. This type of diversification contributes to enriching the innovation ecosystem and exploiting synergies between different sectors.

## *DISCUSSION AND CONCLUSION*

The topic area is particularly actual, as the economic and social impact of science parks is decisive both regionally and internationally. In recent decades, science parks have undergone great development, constantly adapting to the challenges of a changing world and current trends, which have given rise to more and more innovation ecosystems, where industry, universities and the state act through joint cooperation to achieve social and economic well-being. The aim of the research was to examine the presence of universities in various science parks. Based on the literature outlook and the use of various statistical methods, it can be stated that the importance of universities is cardinal for the development of science parks. As a foundation for the subject area, the literature presents the development curve of science parks, highlighting the crucial role of academia in the growth of

science parks, and the importance of industry-university cooperation and the obstacles to such cooperation. For the sake of completeness, the drivers of university internationalisation and the characteristics of university research parks are explored. The literature review confirms the research, as the various literatures reviewed show the impact of university involvement on the life of the science park.

The reviewed literature emphasized the transformative role universities play within science parks, highlighting their ability to integrate research excellence with industrial innovation. Studies underline that the involvement of universities significantly enhances the innovation activities of science parks, demonstrated by higher rates of patent applications and product commercialization. Furthermore, the diversity of university strategies, such as active engagement and regional commitment, aligns with fostering innovation ecosystems that meet both economic and societal needs. These findings reinforce the conclusion that universities are not merely stakeholders but pivotal drivers in shaping the optional and developmental trajectories of science parks. After the theoretical overview, the distribution of science parks by country was analysed, showing that Spain was the country with the largest number of science parks for the representative research. In addition to the number of science parks, the number and nature of their founders is also decisive. Among the founders of science and technology parks, only a university or university appears to a significant extent in cooperation with other organizations, which underpins assumptions stemming from literary research, since universities exert an influence on the operation and development arc of the science park by playing a large role in the circle of founders. Great Britain, Finland and Spain have higher than average numbers of university-founded parks, so future research could be needed to examine the relationships between these areas. The result of the cross-tabulation analysis confirms the qualitative results, based on which it can be concluded that there is a significant relationship between the circle of founders of the science park and the nature of the established science park. During the relationship established here, the university aspect was a focus area, according to which it can be stated that almost half, 46%, of the 95 science parks participating in the research are pure university or mixed with universities and other actors, and 40% of their nature is also university-focused, so the role of the university is highly decisive.

The research focused on European science and technology parks, the methodology can also be applied to the analysis of non-European parks, which could be an extension of the research. Another related research direction may be the examination of the functional connections of universities and the deeper analysis of the role of universities in parks. A further limitation of the study is that it uses the results of a data collection of 95 parks, in which Spanish parks are over-represented, so it is worthwhile to carry out the research on a larger scale to get a more comprehensive representation of the real situation. Real-life experience and the ZalaZONE case study also confirm the hypotheses that the role of universities influences the development of the science park, as it has a positive impact on knowledge flows and stimulates innovation.

**List of figures**

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