Comprehensive study of Technology Transfer Ecosystem

Country: Slovakia

WP2:A4

Prepared by The Slovak Centre of Scientific and Technical Information (CVTI SR)

Date: October 2024

1 Content

1. Introduction 3
1.1 Work methodology 4
2. Background/Environment 5
2.1 EIS 8
2.1.1 European Innovation Scoreboard 2024 – Slovakia 9
2.1.2 Regional Innovation Scoreboard - Slovakia 2024 19
2.2 Legislative Frameworks 23
3. Strategy for TT 25
3.1 Global strategy of HEIs in TT 28
3.2 Map of Stakeholders 29
4 TT Structures 48
4.1 TT System Scheme 54
4.2 TT Procedures 57
4.3 Strengths and Weaknesses of TT Units/Offices 61
4.4 TT Structure Best Practiques 62
5 TT Instruments 66
5.1 Exchange of Research Staff with Companies 68
5.2 Internationalization of Knowledge Transfer 69
5.3 Tools Used to Publicize the Generated Knowledge 70
5.4 Barriers to the Commercialization of Knowledge Generated in HEIs 70
5.5 TT Instruments Best Practiques 72
6 Economic Indicators and Funding 73
6.1 Distribution of the Budget Among the Involved Agents 73
7 Human Resources and Training 74
8 Relationships Between the Agents of the Ecosystem 75
9 Public Administration 78
10 Conclusions 80
11 Bibliographic References 83

1. Introduction

***Output Description**: Within the scope of the activity, main actors, legislative frameworks, support mechanisms, problems, opportunities and risks on the public, academia and industry sides in TT processes will be outlined.* *Each PP will prepare a report revealing the situation in their country, then the reports will be consolidated, and a joint comprehensive study report of TT Ecosystem will be prepared. The joint report will contain a section which includes profiles of countries and stakeholders.* *Thus, different countries and stakeholders will be able to benchmark their situations within the framework of TT. In this way, it will be ensured that the practices that stand out in the studies carried out in PP organizations and countries will be determined. Therefore, the output, comprehensive study reports, will be the basis for all activities and outputs of the project.* *The final objective is to understand how TT works in each country.*
Each PP should explain whether there are characteristics at regional level that make the study particularities at the national level (for example, if there are regions where TT has a different advance than others).

Technology transfer (TT) refers to the process of conveying results stemming from scientific and technological research to the market place and to wider society, along with associated skills and procedures, and is as such an intrinsic part of the technological innovation process. Technology transfer is a complex process that involves many non-scientific and non-technological factors, and many different stakeholders. Good or high quality research results are not enough for successful technology transfer; general awareness and willingness both at the level of organisations and individuals, as well as skills and capacity related to specific aspects, such as access to risk finance and intellectual property (IP) management, are also necessary components.

The fundamental steps of the technology transfer process are depicted in the Figure 1. Technology transfer covers the complex value chain linking research to its eventual societal deployment. This begins with the discovery of novel technologies at research institutions, followed by the disclosure, evaluation and protection of these technologies. The next steps include marketing, potential licencing agreements and the development of products based on the technical inventions. The financial returns of these products can then, for instance, be used for further research [24].

The concept of technology transfer (TT) has several meanings or contexts in which it can be used. TT can be understood as an effort to develop backward countries by means of technology offers (transfer) from more advanced countries. But TT can be understood also as technology transfer in the commercial sphere among several companies or within the frame of one company among its individual units. The third meaning of the TT is technology transfer from academia to commercial sphere. Even this third meaning is interesting for us in the process of creating the National technology transfer support system (NSPTT) in Slovakia. NSPTT will support the process of technology transfer from academia to commercial sphere [55].

Figure 1: Technology Transfer Process. Source: EC (2023)

Technology transfer is the comprehensive process of transfering scientific knowledge (use), inventions, findings and knowledge caused by research activities in public sector into the economic and social practice focused on their commercial evaluation. Main phases of this process are intellectual property protection and its subsequent commercialisation. In the framework of these two phases we can identify following activities that can create steps in the process of technology transfer.

Within the scope of the activity A4 (Comprehensive Study of Technology Transfer Ecosystem) in WP2, main actors, legislative frameworks, support mechanisms, problems, opportunities and risks on the public, academia and industry sides in TT processes will be outlined.

CVTI SR as a project partner have prepared a report revealing the situation in Slovakia. The final objective of this report is to understand how TT works in Slovakia.

There are characteristics at the regional level that make the study particularities at the national level (for example, if there are regions where TT has a different advance than others). More innovative regions with universities (e.g. Bratislava and Košice) have different advance than other Slovak regions.

1.1 Work methodology

Description of the methodology used to carry out the study (works consulted, interviews and surveys carried out).

In this section, Each PP should explain which actions have been carried out to make the study (for instance, based on experts interviews, surveys or references) and what is the general situation observed in terms of interest in the topic (for example, it has been easy to identify these entities/persons, they have been willing to participate, and if the general perception has been positive versus the STEIDA project).

This study has been carried out on the basis of a desk research of different Internet sources, e.g. scientific papers, reports, articles, proceedings from the international conferences related technology transfer (COINTT), statistical data (EC, VAIA, Statistical Office of the Slovak Republic), etc. Other sources used during desk research were information from web sides of relevant organizations and stakeholders involved in the TT ecosystem in Slovakia.

During the work on the study of TT ecosystem in Slovakia we have used following activities:

- Analysis of existing bibliography and references:
- Map o main stakeholders: Mapping the TT ecosystem in Slovakia and identification of key players was provided with support of TTC at CVTI SR.
- Expert interviews: Expert interviews we carried out at TTC CVTI SR and selected Slovak technology transfer centres at Slovak University of Technology in Bratislava and Pavol Jozef Šafárik University in Košice.
- Survey between Technology Transfer Offices (TTOs) in Slovakia was realised in September-October 2024 and has been carried out to collect information from TTOs in Slovakia. Through this format 10 Slovak TTOs were contacted by e-mail and phone and we have received 7 completed surveys.

2. Background/Environment

The environment for TT should allow us to analyse the maturity of the country in these terms, as well as to understand how easy is to develop actions and possible barriers.

In this section, we analyse the legislative framework and the structure of stakeholders.

As a previous point, we should reflect whether this environment is "new" (if it has had evolutions in recent years) or if on the contrary it is something that has been developing for many years.

Analyse economic Indicators and budget evolution in order to understand the impact and evolution of TT in your country.

In this section, we have analysed economic indicators, innovation performance, the legislative framework and the structure of stakeholders in Slovakia. We have analysed economic indicators and budget evolution in order to understand the impact and evolution of TT in Slovakia.

Economic indicators

Economic forecast for Slovakia

Slovakia's economy is closely linked to globalisation and the country will be strongly impacted by the technological revolution currently unfolding in the manufacturing sector. In order to respond to current and future changes and to maintain its competitiveness, Slovakia needs to continue to improve its RTDI system [45].

The latest macroeconomic forecast for Slovakia was presented by EC on May 2024 (see Table 1). Slovak GDP is forecast to expand by 2.2% in 2024, on the back of growth in private and public consumption. In 2025 the GDP growth is forecast to reach 2.9% supported by domestic demand.

Inflation is projected to decelerate strongly to 3.1% this year, but to pick up to 3.6% in 2025 amid the expected convergence of energy prices to market levels. Amid tight labour market, real wages are set to increase. Public deficit is expected to increase to 5.9% of GDP in 2024 before decreasing slightly to 5.4% in 2025 as energy-support measures are assumed to wind down.

Indicators	2023	2024	2025
GDP growth (%, yoy)	1,6	2,2	2,9
Inflation (%, yoy)	11,0	3,1	3,6
Unemployment (%)	5,8	5,4	5,2
General government balance (%, GDP)	-4,9	-5,9	-5,4
Gross public dept (% of GDP)	56,0	58,5	59,9
Current account balance (%, of HDP)	-0,7	-2,0	-2,5

Table 1: Macroeconomic forecast for Slovakia. Source: EC (2024a)

Real GDP grew by 1.6% in 2023, primarily reflecting the decline in private and public consumption. The weaker economic performance of the country's major trade partners resulted in a decline of exports and some deterioration in Slovakia's market share.

Looking forward, economic activity is expected to accelerate in 2024 as private and public consumption resume growth and exports rebound strongly due to firming external demand. Government support measures are expected to continue limiting the impact of high energy prices for households and businesses in 2024. Furthermore, the projected real wage increases should provide an extra stimulus for private consumption. However, investment growth is set be limited in 2024, following a notable jump by 10.6% in 2023 as Slovakia intensified its use of EU funds by the end of the year. In 2025 investment is expected to pick up pace to a great extent driven by absorption of EU structural funds and the Recovery and Resilience Facility (RRF). Overall, real GDP growth is projected at 2.2% in 2024 and 2.9% in 2025.

The unemployment rate is expected to continue declining from 5.8% in 2023 to 5.4% in 2024 and 5.2% in 2025, keeping the labour market tight. The main driving force behind decreasing unemployment is the decline in the working-age population, while labour demand remains robust. In 2023, nominal wages growth lagged behind the inflation rate. However, in 2024 and 2025 the compensation of employees is expected to grow markedly faster than inflation, resulting in an increase in real wages.

In 2023 headline inflation remained high at 11% due to elevated inflation of energy and food prices. Inflation declined strongly by the end of the year and continued easing at the beginning of 2024. The government interventions to limit energy prices for households are set to continue throughout the year, contributing to a relatively subdued inflation of 3.1% in 2024. Food price inflation is expected to stabilise, benefiting from a deceleration in input prices. As government measures are projected to be phased out in 2025, energy prices are set to rise towards market prices, keeping energy inflation high and contributing to a relative increase in Harmonised Index of Consumer Prices (HICP) to 3.6% next year. Compared to other components, prices in the services sector are expected to grow more dynamically driven by robust wage growth.

The public deficit increased to 4.9% of GDP in 2023, as a result of energy support, permanent increases in public sector wages and social benefits.

In 2024, the general government deficit is projected to increase further to 5.9%, driven by expenditure measures adopted in 2023. These include a higher compensation of public employees, a family package including a tax bonus, the introduction of a parental bonus under the pension reform together with a full 13th pension payment, and other expenditure-increasing measures. The net budgetary cost of measures to mitigate the impact of high energy prices is set to decline to 0.4% of GDP, compared to 2.1% in 2023. This is expected to be partly offset by new revenue-increasing measures such as the increase in the share of social contributions towards the first (public) pension pillar, a special levy on banks' profits, an increase in medical levies for employers, and an increase in the property tax rate in municipalities.

Given that most of the expenditure measures are of permanent nature, in absence of consolidating measures, the general government deficit is set to remain at a high rate of 5.4% of GDP also in 2025, based on unchanged policies. The deficit decreases in 2024 due to revenue-increasing measures, such as introduced levy on bank profits or increased medical contributions for employers by 1%. The Commission currently assumes a full phasing out of energy support measures in 2025. The deficits in 2024 and 2025 are also driven by postponed delivery of military equipment.

After decreasing to 56.0% in 2023, the government debt-to-GDP ratio is projected to increase to 58.5% in 2024 and to 59.9% in 2025. This increase is driven by high deficits in 2024 and 2025, partly offset by a strong growth of nominal GDP [21].

Budget evolution

The deficit of the general government (GG) reached 4.9 % of GDP in 2023 (see Table 2), marking a return from a temporarily low deficit in 2022 to the high levels seen in the pandemic years 2020 and 2021. Compared to the budgetary target of 6.4 % of GDP, the actual deficit implies a positive deviation of 1.5 % of GDP and, after the years 2021 and 2022, it is also the third most significant improvement in the final fiscal result compared to the budget since 2005. Gross debt stood at 56.0 % of GDP, down by 1.7 p.p. year-on-year, which means that the final value is as much as 1.9 % of GDP lower compared to the budgetary assumptions. However, it is still 2 % of GDP above the upper limit of the debt brake [49].

(in % of GDP)	2018	2019	2020	2021	2022	2023
General government balance	**-1.0**	**-1.2**	**-5.3**	**-5.2**	**-1.7**	**-4.9**
Structural balance	**-1.9**	**-2.0**	**-2.8**	**-1.7**	**-1.3**	**-3.3**
Gross general government debt	**49.4**	**48.0**	**58.8**	**61.1**	**57.7**	**56.0**
Net general government debt	**43.3**	**43.1**	**48.9**	**49.6**	**47.6**	**48.3**
Memorandum items:						
Government's target in approved budget	*-0.8*	*0.0*	*-0.5*	*-7.4*	*-4.9*	*-6.4*
Upper limit of debt brake	*59.0*	*58.0*	*57.0*	*56.0*	*55.0*	*54.0*
Cyclical component	*0.8*	*0.7*	*-0.7*	*-0.1*	*0.7*	*-0.4*
One-off effects	*0.0*	*0.1*	*-1.8*	*-3.4*	*-1.1*	*-1.2*
Change in the structural balance (- means worse)	*-*	*-0.1*	*-0.8*	*1.1*	*0.4*	*-2.0*
Fiscal impulse (+ means restriction)		*-0.9*	*-2.9*	*0.2*	*2.6*	*-4.4*

Table 2: Development of main fiscal indicators. Source: Statistical Office of the Slovak Republic, 2024

From the perspective of long-term sustainability, the long-term economic growth is important. It can be supported by the formation of new capital through effective public investments. In 2023,

public investment reached 4.7 % of GDP, the highest since 2015. The increase was mainly driven by the spending of EU funds from the programming period that is nearing its end, with investment expenditure financed by EU funds and co-financing standing at 2.0 % of GDP.

Because the flow of European funds depends on a longer-term spending plan, as well as on the relevant programming period schedule, it will be interesting to observe the development of domestic public investments. At the same time, it is advisable to deduct the investments related to the military equipment, because the size of these expenditures recorded in the budget balance under ESA 2010 is to a large degree affected by delivery dates. In 2023, the uptake of domestic investments outside the defence sector showed a moderate year-on-year increase; however, unlike in previous years, it surpassed the level of capital expenditures included in the budget. The investments were 0.2 % of GDP higher than expected in the budget; on the one hand, this contributed to a higher structural deficit level, on the other hand, the government managed to sufficiently use the budgetary funds to support investments that are much needed for economic growth. The final size of domestic investments was above the level of historical average since the previous crisis [63].

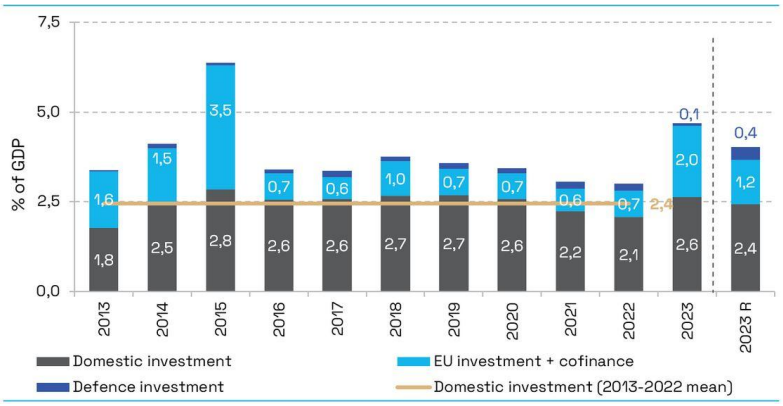


Figure 2: Public investment. Source: Statistical Office of the Slovak Republic, 2024

2.1 EIS

The regional innovation scoreboard (RIS) is a regional extension of the European Innovation Scoreboard (EIS), assessing the innovation performance of European regions on a limited number of indicators. The RIS 2023 provides a comparative assessment of the performance of innovation systems across 239 regions of 22 EU countries.

In this section, it is required an analysis of the situation of the country according to the RIS, highlighting (and interpreting) the results of the parameters that have the greatest impact on the study.

Specifically, it is proposed to analyse: PhD graduates, Attractive research systems, Finance and support, Firm investments, Innovators, Intellectual assets, portfolio of patents, spinoff creation as well as the Relative strengths and Relative weaknesses section.

Bulgaria : https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-bg.pdf
Regional : https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-bulgaria.pdf
Croatia : https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-hr.pdf
Regional: https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-croatia.pdf
Slovakia: https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-sk.pdf
Regional : https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-slovakia.pdf
Slovenia: https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-si.pdf
Regional: https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-slovenia.pdf

Spain : https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-es.pdf
Regional : https://ec.europa.eu/assets/rtd/ris/2023/ec_rtd_ris-regional-profiles-spain.pdf
Türkiye: https://ec.europa.eu/assets/rtd/eis/2023/ec_rtd_eis-country-profile-tr.pdf
Regional : No info

Methodology and indicators : https://research-and-innovation.ec.europa.eu/document/download/5357c81b-9222-464b-8468-38ccd83b5624_en?filename=ec_rtd_ris-2023-methodology-report.pdf

Interactive EIS Tool : https://projects.research-and-innovation.ec.europa.eu/en/statistics/performance-indicators/european-innovation-scoreboard/eis

2.1.1 European Innovation Scoreboard 2024 – Slovakia

The European Innovation Scoreboard (EIS) provides a comparative assessment of the Research and innovation (R&I) performance of EU Member States, other European and selected third countries (global competitors). It helps stakeholders assess areas in which they need to concentrate their efforts to boost innovation performance, considering the national socio-economic context (which is captured by a complementary set of structural indicators to help interpret the results). The EIS results can help reveal which dimensions of national innovation systems are especially weak or strong and thus should be the subject of attention from policymakers [22].

Slovak position in international rankings and statistics during the last period did not change significantly. In international comparisons with other EU members Slovakia places stable on the last positions with low innovation performance. For example in the EIS 2024 evaluation, Slovakia is still earned in the fourth group of states – emerging innovators, together with Croatia, Poland, Latvia, Bulgaria and Romania. **In EIS 2024 Slovakia placed 24th (out of 27 EU member states and 28th in the overall ranking** with innovation performance **65,1 % of EU average.**

Total innovation index has a value of 71,6, which represents a slight improvement, saying that compared to the year 2023, its value increased by 1,5 points, and since the year 2017, the index has increased by a total of 2,6 points.

The innovation performance in Slovakia is, however, lower than the EU average, so even though Slovakia is making progress, it is not keeping pace with the overall improvement at the EU level. As a result, Slovak relative position compared to other EU countries does not improve so much that, if it could, it would reach or exceed the average growth rate of innovation performance in the EU.

According to the findings, Slovakia slightly improved its innovation performance, but most EU countries are progressing faster. Slovakia's strengths include the ability of Slovak entrepreneurs to export products with high added value and environmental sustainability. On the contrary, the low level of research funding, an unattractive research environment or a low share of small and medium-sized companies dedicated to innovation remain weaknesses.

Slovak results profile points to several strong and weak points. The country excels in the export of medium and high technology products and in the sale of new-to-market and new-to-firm innovations and in innovations in the field of emissions of fine dust particles into the air. However, Slovakia faces challenges in the field of human resource mobility in science and technology (HRST) between individual jobs, R&D expenditure in the business sector and design applications.

Figure 3 shows the scores for the summary innovation index (SII) for all EU Member States in 2024 (the baseline being the EIS SII score for 2017), compared to their SII score in 2023: 12 Member States rank above the EU average and 15 below. Slovakia belongs to the countries below the EU average.

Based on their performance relative to the EU average in 2024, Member States fall into four different performance groups. In performance order, Denmark, Sweden, Finland and the Netherlands are **Innovation Leaders** with innovation performance well above the EU average (above 125% of EU average). Belgium, Austria, Ireland, Luxembourg, Germany, Cyprus, Estonia and France are Strong Innovators with performance above the EU average. Slovenia, Spain, Czechia, Italy, Malta, Lithuania, Portugal, Greece and Hungary are Moderate Innovators with performance below the EU average. Croatia, Poland, **Slovakia**, Latvia, Bulgaria and Romania are **Emerging Innovators** with performance well below the EU average (below 70% of EU average).

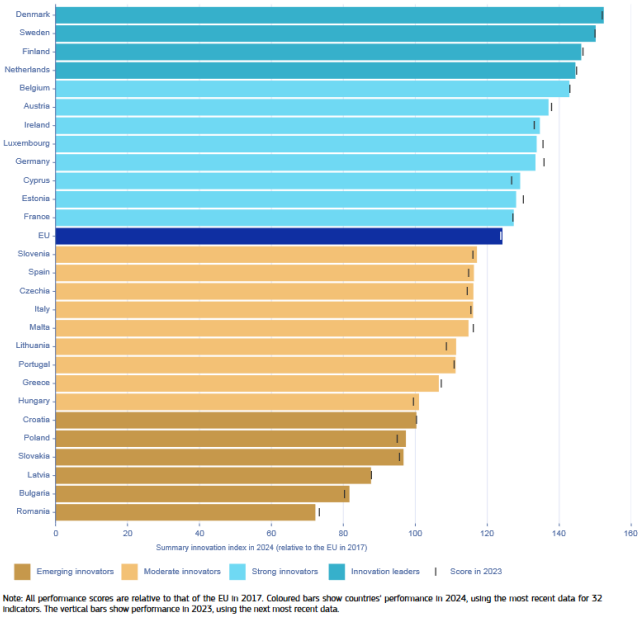


Figure 3: Innovation performance of the EU Member States, relative to the EU in 2017 and compared to national performance in 2023. Source: EIS 2024

Slovakia is below the EU average in 2024 in all framework condition dimensions. Human resources (78.6% of the EU average in 2024) have seen a notable decline (-20.3%-points), primarily due to significant reductions in new doctorate during the period 2017-2024. Conversely, Slovakia has made substantial progress in the attractiveness of its research systems (50.7 of the EU average in 2024) with an increase of 19.2%-points, marked by significant gains in international scientific co-publications (+25.9%-points), foreign doctorate students (+27.8%-points) and top cited scientific publications (+12.5%-points).

The efforts towards digitalisation have seen significant progress, including notable increases in broadband penetration and modest improvements in individuals with above-basic overall digital skills. This trend is expected to be further supported by the National Digital Decade Roadmap for 2030, which focuses on digital skills, digital infrastructure, digital transformation of businesses, and digitalisation of public services.

As we can see more in detail in the Table 4 Slovakia has recorded relative strengths in Exports of medium and high technology products, Sales of new-to-market and new-to-firm innovations and in Air emissions by fine particulates. On the other hand relative weaknesses were in Job-to-job mobility of HRST, R&D expenditure in the business sector and in Design applications.

Strong increases since 2017 were in Direct and indirect government support of business R&D, Broadband penetration, Public-private co-publications.

Strong decreases since 2017 were in R&D expenditure in the public sector, Environment-related technologies and in New doctorate graduates.

According comparison with 2023, strong increases since 2023 were recorded in Sales of new-to-market and new-to-firm innovations, Innovative SMEs collaborating with others, Direct and indirect government support of business R&D.

Strong decreases since 2023 were in Population involved in lifelong learning, Environment-related technologies and New doctorate graduates [22].

Indicator	Performance relative to the EU in 2024	Performance change 2017-2024	Performance change 2023-2024
SUMMARY INNOVATION INDEX	**65.1**	2.6	1.5
Human resources	**78.6**	**-20.3**	**-9.6**
New doctorate graduates	73.8	-34.8	-11.6
Population with tertiary education	82.0	1.8	4.2
Population involved in lifelong learning	80.5	-23.5	-23.5
Attractive research systems	**50.7**	19.2	3.9
International scientific co-publications	64.5	25.9	1.5
Scientific publications among the top 10% most cited	38.6	12.5	3.4
Foreign doctorate students as a % of all doctorate students	57.4	27.8	7.1
Digitalisation	**66.8**	18.8	5.9
Broadband penetration	60.2	33.9	7.8
Individuals with above basic overall digital skills	75.9	3.9	3.9
Finance and support	**46.8**	**-9.2**	6.5
R&D expenditure in the public sector	49.2	-67.2	3.3
Venture capital expenditures	44.7	13.5	1.2
Direct and indirect government support of business R&D	46.7	48.8	17.3
Firm investments	**58.8**	17.7	1.3
R&D expenditure in the business sector	36.1	18.0	3.8
Non-R&D innovation expenditures	100.7	16.2	-1.7
Innovation expenditures per person employed	44.3	18.7	1.6
Use of information technologies	**71.3**	**-11.2**	**-4.1**
Enterprises providing ICT training	59.7	-19.8	-5.1
Employed ICT specialists	82.3	-3.2	-3.2
Innovators	**45.5**	15.2	**-1.2**
SMEs introducing product innovations	48.4	15.2	6.4
SMEs introducing business process innovations	43.3	15.5	-7.8
Linkages	**55.1**	18.1	9.0
Innovative SMEs collaborating with others	71.5	12.0	20.4
Public-private co-publications	85.4	30.1	1.5
Job-to-job mobility of HRST	29.2	17.7	3.0
Intellectual assets	**51.2**	2.4	**-1.3**
PCT patent applications	40.5	-2.9	2.0
Trademark applications	80.3	21.5	2.3
Design applications	36.2	-5.5	-7.9
Employment impacts	**56.4**	12.0	8.3
Employment in knowledge-intensive activities	65.2	2.4	-1.2
Employment in innovative enterprises	49.1	20.9	17.1
Sales impacts	**87.4**	**-2.9**	8.6
Exports of medium and high technology products	115.4	3.8	9.4
Knowledge-intensive services exports	41.2	12.3	-7.9
Sales of new-to-market and new-to-firm innovations	115.3	-33.9	30.2
Environmental sustainability	**90.9**	**-7.1**	**-6.2**
Resource productivity	78.3	17.9	6.2
Air emissions by fine particulates	101.8	9.9	-1.6
Environment-related technologies	87.1	-52.5	-23.4

Emerging Innovators Moderate Innovators Strong Innovators Innovation Leaders

Table 3: European Innovation Scoreboard 2024 – Slovakia. Source: EIS (2024)

PhD graduates

The Human Resources dimension measures the availability of a high-skilled and educated workforce and includes three indicators: **New doctorate graduates in STEM**, Population aged 25-34 with completed tertiary education, and Population aged 25-64 involved in lifelong learning activities.

Romania, Bulgaria, and Hungary have the lowest performance in human resources, with scores below 50, which is half the EU average in 2017. While Hungary's score has remained stable between 2023 and 2024, Bulgaria and Romania have slightly increased their performance (Figure 4).

The summary index for Human resources was 78,6, for New doctorate graduates was recorded at 73,8. New doctorate graduates has recorded strong decrease since 2017 [22].

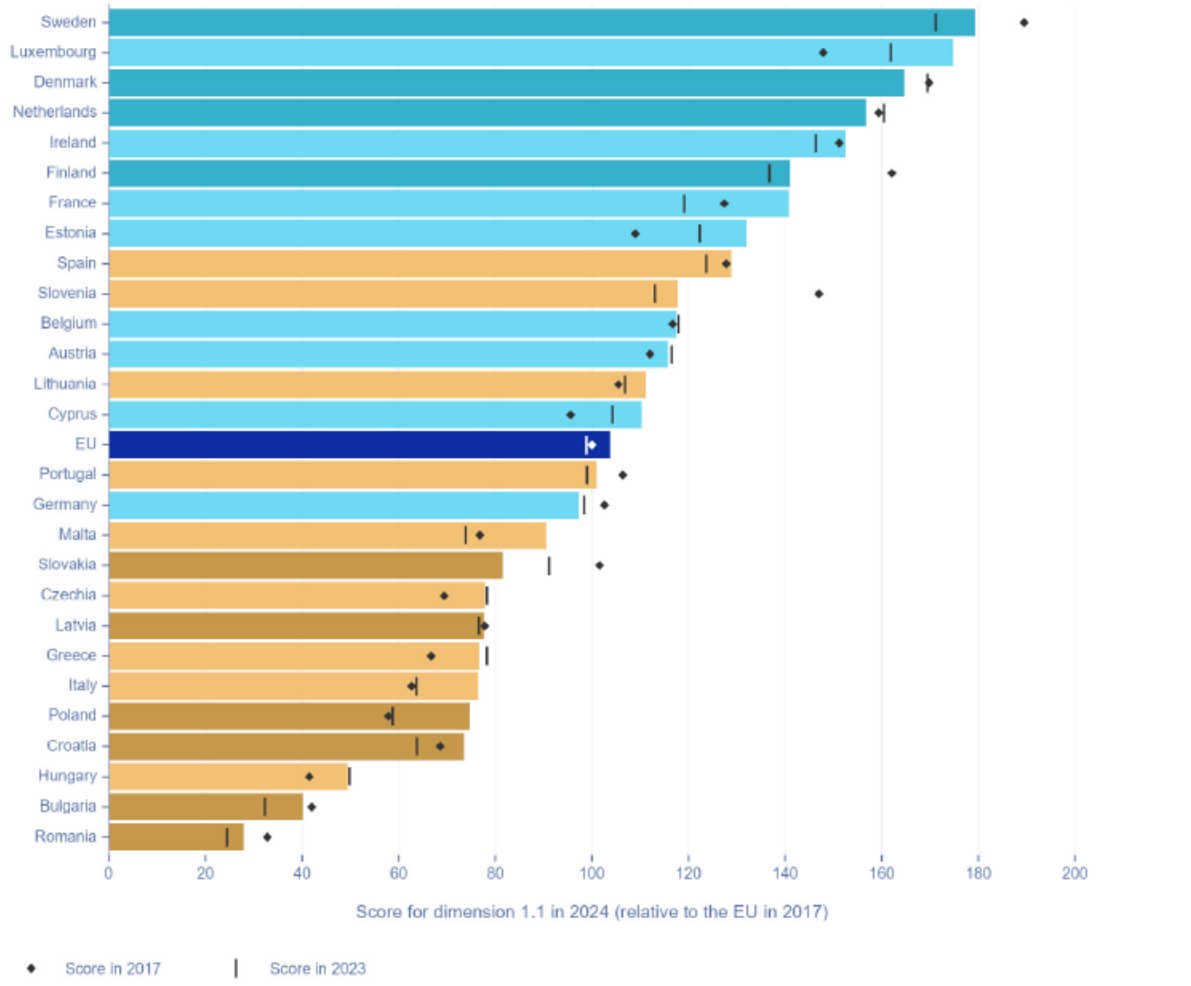


Figure 4: Innovation performance of the EU Member States in the Human Resources dimension. Source: EIS (2024)

Attractive research systems

The Attractive Research Systems dimension measures the international competitiveness and attractiveness of the national science base by considering the number of international scientific co-publications, of most cited publications, and of foreign doctorate students. At the other end of the scale, one Moderate Innovator, Greece, and two Emerging Innovators, Bulgaria and Latvia, record the lowest performances with scores below 70 (Figure 5). To this group of countries belongs also Slovakia with summary innovation index 50,7 [22].

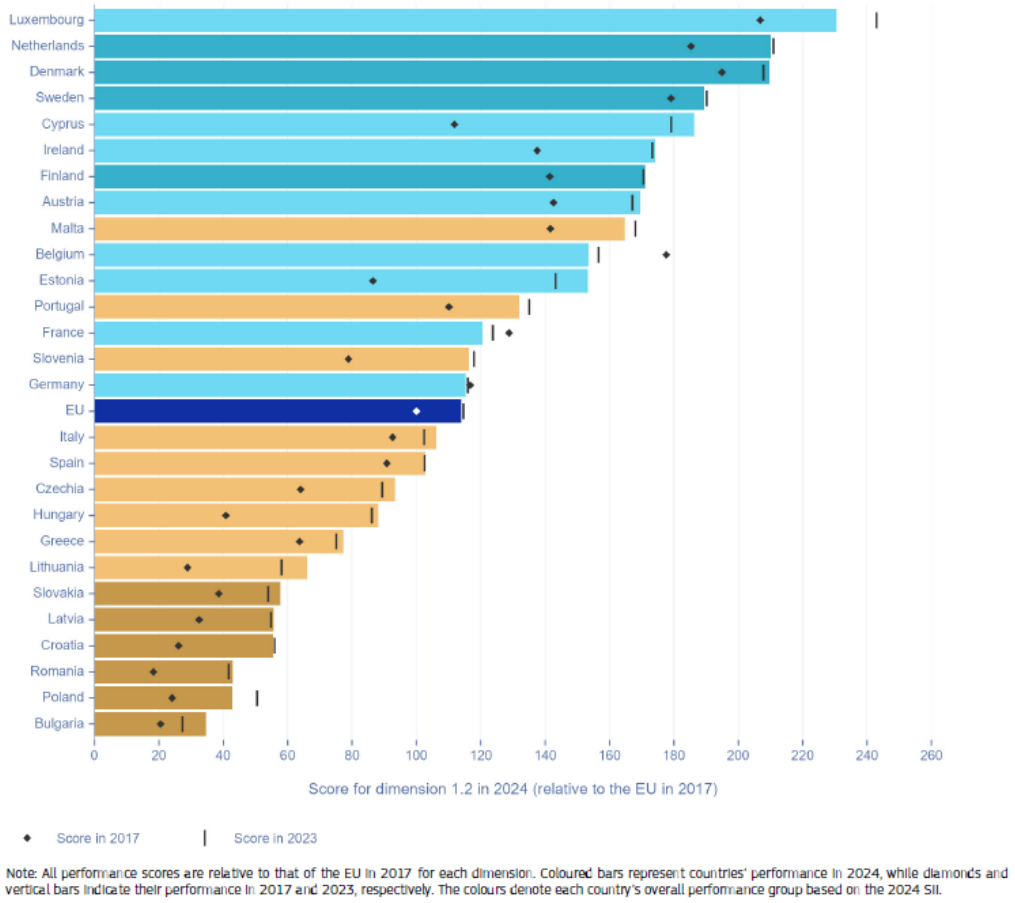


Figure 5: Innovation performance of the EU Member States in the Attractive Research Systems dimension. Source: EIS (2024)

Finance and support

The Finance and Support dimension measures the financing capacity of innovation, and includes three indicators: Venture capital investments, R&D expenditures in universities and government research organisations, and Direct government funding and tax support for business R&D.

As we can see in the following Figure, the bottom-five is composed of one Strong Innovator, Cyprus, one Moderate Innovator, Malta, and three Emerging Innovators, Romania, Bulgaria, and Latvia (Figure 6). These countries record the lowest performances in the Finance and Support Dimension, with scores below 50. In this group of countries is also Slovakia with summary innovation index 46,8 [22].

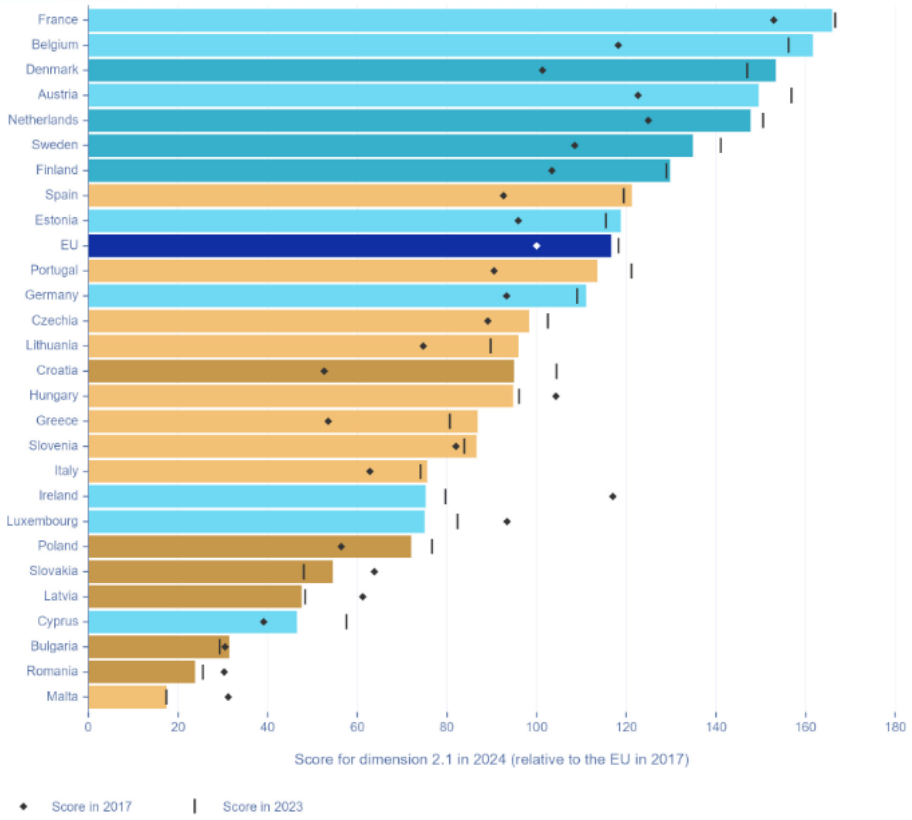


Figure 6: Innovation performance of the EU Member States in the Finance and Support. Source: EIS (2024)

Firm investments

The bottom five is composed of one Strong Innovator, Luxembourg, and four Emerging Innovators, Croatia, Bulgaria, Latvia and Romania. Latvia and Romania remain the countries with the lowest performances on this dimension, with scores below 30.

Overall, 20 out of the 27 Member States perform below the EU average in 2024 on the Firm Investments dimension. Among Innovation Leaders, one country (the Netherlands) scores below the EU average in 2024. Most Strong Innovators perform below the EU average, with only Austria and the top performing countries, Germany and Belgium, exceeding the EU average score. A similar trend was observed among Moderate Innovators, with all except Czechia scoring below the EU average. All Emerging Innovators are in the bottom half of the ranking on this dimension. Slovakia with summary innovation index 46,8 belongs to the group of countries below the EU average (Figure 7).

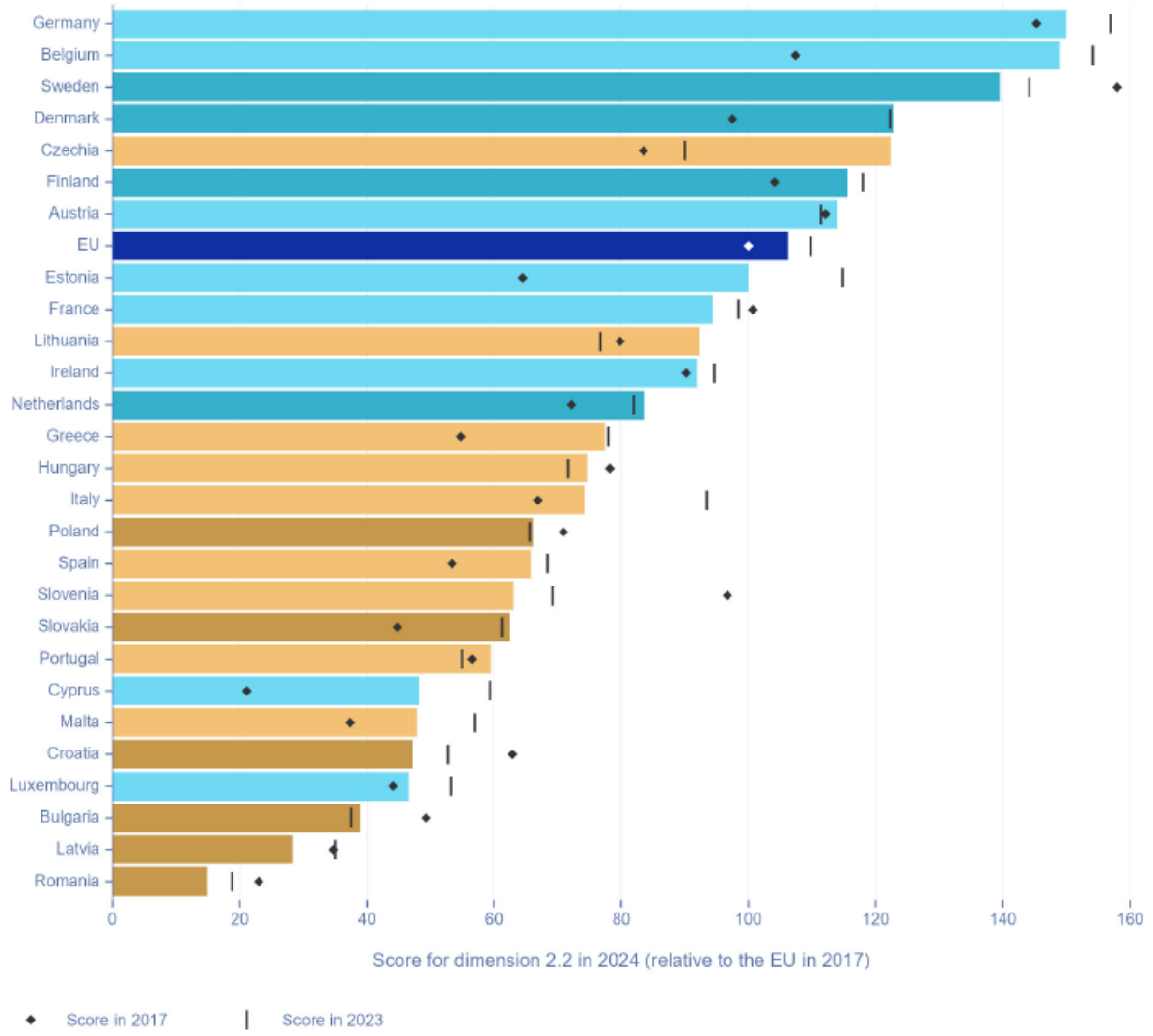


Figure 7: Innovation performance of the EU Member States in the Firm investments. Source: EIS (2024)

Innovators

The Innovators dimension concerns SMEs that have introduced innovations on the market or within their organisations, by measuring the introduction of both products and businesses process innovations by SMEs. The innovators dimension is entirely based on CIS which has been updated with CIS 2022 data provided as part of the CIS fast-track for 19 Member States. CIS fast-track is an early data submission process for several indicators collected on a voluntary basis. Please note that fast-track data are considered preliminary.

As we can see from the Figure, despite slight improvements over the years, several Member States perform 30% below the 2017 EU average, on the Innovators dimension. These include three

Moderate Innovators, Hungary, Malta and Spain, and five Emerging Innovators, Romania, Bulgaria, Poland, Slovakia and Latvia. Slovakia has summary innovation index 45,5 (Figure 8).

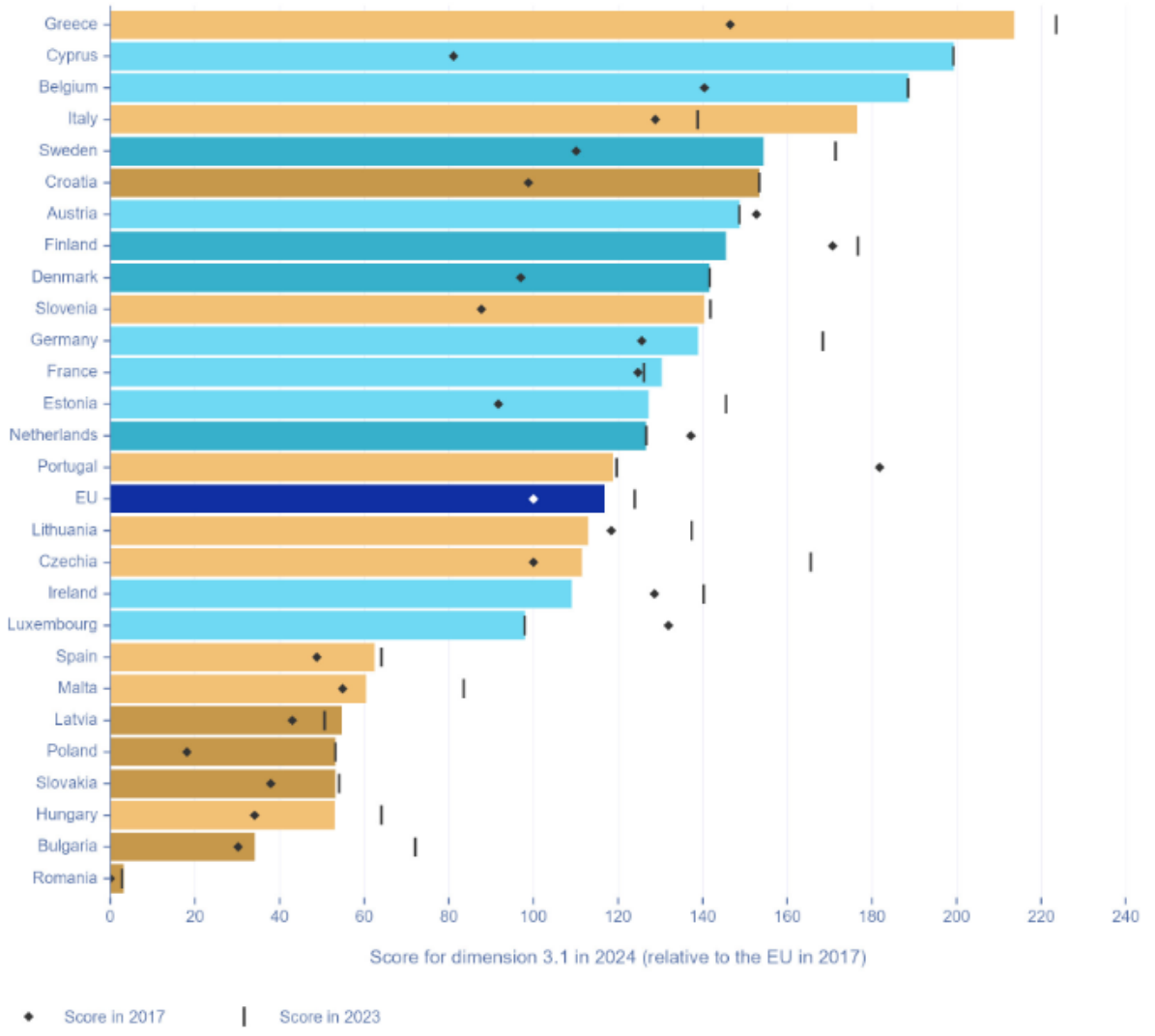


Figure 8: Innovation performance of the EU Member States in Innovators. Source: EIS (2024)

Intellectual assets

The Intellectual assets dimension captures different aspects of Intellectual Property Rights (IPR), as measured by Patent Cooperation Treaty (PCT) patent applications, Trademark applications, and Design applications.

The three best-performing Member States in the Intellectual Assets dimension are a Strong Innovator, Austria, an Innovation Leader, Denmark, and a Moderate Innovator, Malta, with Austria moving into the lead over Denmark. The bottom-five is composed of two Moderate Innovators, Hungary and Greece, and three Emerging Innovator, Croatia, Slovakia and Romania, with the latter having the lowest innovation performance in 2024. Slovakia with summary innovation index 51,2 belongs to bottom group of countries (Figure 9).

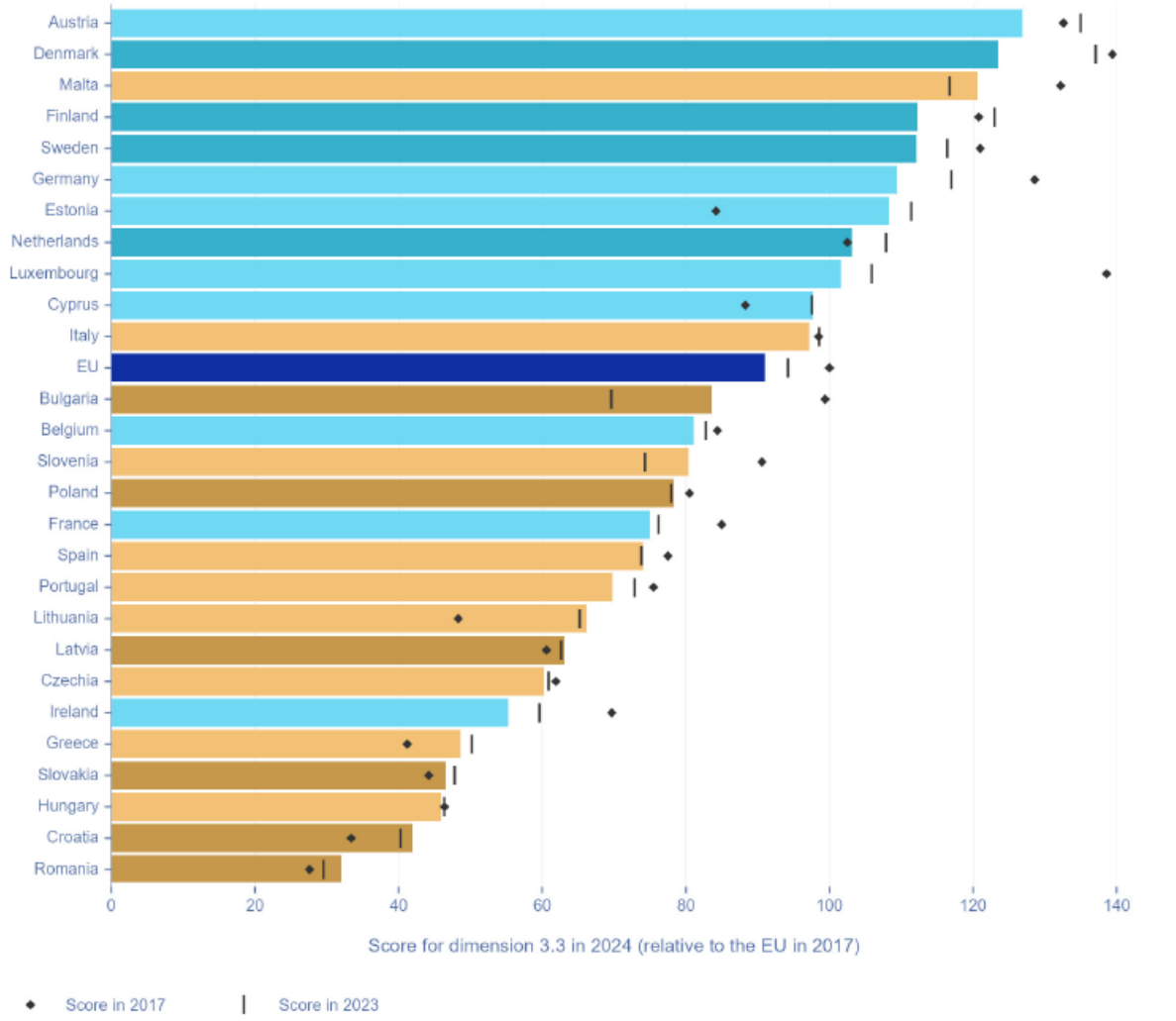


Figure 9: Innovation performance of the EU Member States in Intellectual assets. Source: EIS (2024)

Portfolio of patents

The Intellectual assets dimension captures different aspects of Intellectual Property Rights (IPR), as measured by Patent Cooperation Treaty (PCT) patent applications, Trademark applications, and Design applications.

The three best-performing Member States in the Intellectual Assets dimension are a Strong Innovator, Austria, an Innovation Leader, Denmark, and a Moderate Innovator, Malta, with Austria moving into the lead over Denmark. The bottom-five is composed of two Moderate Innovators, Hungary and Greece, and three Emerging Innovator, Croatia, Slovakia and Romania, with the latter having the lowest performance in 2024. The summary innovation index for PCT patent applications in Slovakia was 40,5 [22].

In the area of patent activity measured by PCT applications, the Slovakia is compared with the EU level at 33.1%. If we take into account the dynamics of changes in the framework period 2016-2023, so in this activity Slovakia recorded a positive change of 3.3% [120].

Spin-off creation

The formation of university-spin off is seen as a potential tool for the transfer of knowledge and technology. University spin-off firms are able to transform the knowledge accumulated in research into its practical application and commercialization. Despite this fact, the formation of university spin-off is still rather rare phenomenon in many European countries [32].

The establishment of spin-off companies in an academic environment represents the least used way of commercializing intellectual property in our conditions. To a large extent, this is related to the complexity of the process itself, but it would be a mistake to neglect other factors that predetermine this state [11].

There are various examples how Slovak universities supports spin-off creation.

Slovak University of Technology (STU) has created own company STU Scientific. The company was founded as a unique workplace of a public university with the aim to ensure the transmission of the results of university science, technology and arts into the economic and social practice. The company's mission is to promote economic recovery of intellectual property of the STU, members of the academic community and its other partners in the business environment. This means in particular the recovery of new knowledge, know-how, technical solutions arising from research and other creative activities in one of the latest methods proven worldwide [88].

An example of the successful establishment of a university spin-off company in Slovakia is SAFTRA Photonics with headquarters in Košice. SAFTRA Photonics is a Slovak high-tech company established as a spin-off from the Pavol Jozef Safarik University in Kosice in 2014. The development and the business strategies of the company are based on the research activities in the fields of photonics and biomedical research and development [67].

Relative strengths

- Exports of medium and high technology products
- Sales of new-to-market and new-to-firm innovations
- Air emissions by fine particulates

Relative weaknesses

- Job-to-job mobility of HRST
- R&D expenditure in the business sector
- Design applications

Conclusion

Slovakia is an Emerging Innovator with performance at 65.1% of the EU average in 2024. Performance is above the average of the Emerging Innovators (48%). Performance is increasing less than the EU (+10%).

Looking on the comparison with EU average (see Figure 10), since 2017 with small decrease in 2018 further development of Slovakia was stagnating with moderate increase.

Slovakia experienced significant fluctuations over the period, with a major drop in 2018 (-5%-points), followed by gradual improvements, in particular in 2020 (4%-points). The overall improvement between 2017 and 2024 is 3%-points which suggests a recovery, although modest compared to other countries.

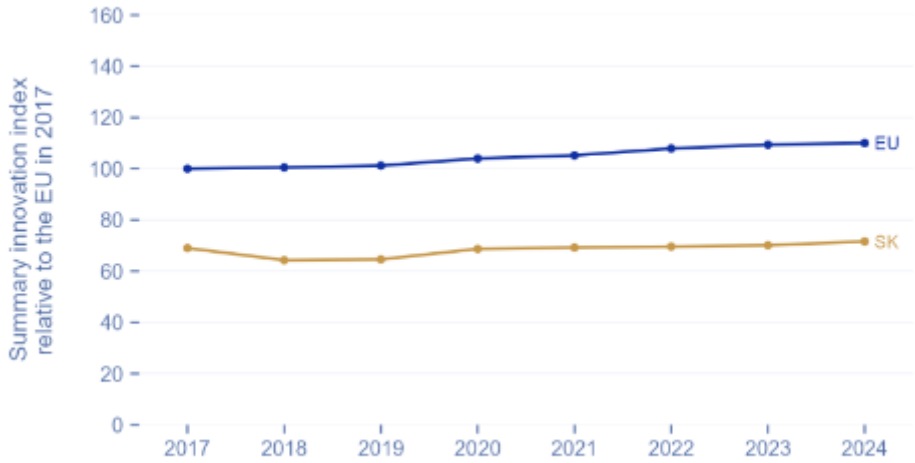


Figure 10: Summary Innovation Index. Source: EIS (2024)

2.1.2 Regional Innovation Scoreboard - Slovakia 2024

Research and Innovation Authority (VAIA) in Slovakia has published in August 2024 the *Regional Innovation Score of Slovakia* (KISS) in which took a detailed look at the innovation performance of Slovak regions [118].

Ranking at the regional level completes the overall image of Slovak innovation performance (Figure 11 and Table 4) and provides an overview of the situation in regions where the Research and Innovation Authority (VAIA) aims to increase competitiveness and improve the quality of life through support for research, development and innovation.

Key facts:

- From the analysis given in the years 2021 and 2022, it follows that Bratislava region is the most innovative region in Slovakia with a significant lead, which is a typical position before the capitals and in other European countries.
- However, the biggest year-on-year change was recorded by the Banská Bystrica region, which jumped ahead of schedule, mainly thanks to top scientific publications, ICT

employees and a significant improvement in emissions in the industry. In the end, they managed to jump from 7th place in 2021 to 3rd place in 2022.

Mapping regional differences in key areas of research, development and innovation provide important information for policymakers not only at the national level, but especially at the regional level with the possibility of continuing measures aimed at specific regional challenges.

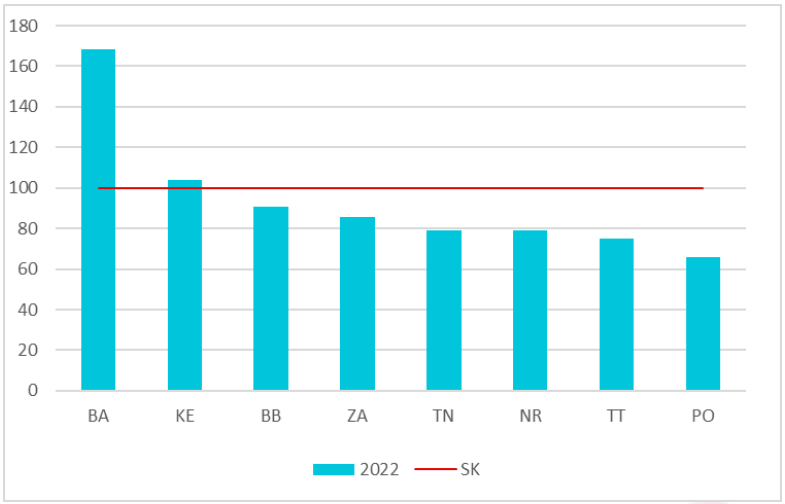


Figure 11: Comparison of Slovak regions (NUTS III). Source: VAIA (2024)

	2021	2022	Change
Slovakia total	**100,000**	**100,000**	**-0,945**
Bratislava (BA)	162,636	168,491	5,016
Trnava (TT)	77,390	74,954	-2,498
Trenčín (TN)	80,460	79,021	-1,480
Nitra (NR)	79,241	78,904	-0,086
Žilina (ZA)	84,891	85,806	0,454
Banská Bystrica (BB)	77,920	90,938	9,917
Prešov (PO)	91,337	65,858	-25,758
Košice (KE)	126,989	103,841	-21,701

Table 4: Regional Innovation Scoreboard - Slovakia 2024. Source: VAIA (2024)

PhD graduates

The Human Resources dimension measures the availability of a high-skilled and educated workforce and includes three indicators: New doctorate graduates in STEM, Population aged 25-34 with completed tertiary education, and Population aged 25-64 involved in lifelong learning activities.

The highest number of PhD graduates in STEAM was recorded in Bratislava and Košice regions, as main university centre in Slovakia (see Table 5 and Figure 12)

	2021			2022		
	PhD graduates in STEM	Population 25-34	**Indicator**	PhD graduates in STEM STEM	Population 25-34	**Indicator**
SR total	**504**	**737485**	**0,68**	**469**	**713147**	**0,66**
Bratislava region	235	95886	2,45	253	91599	2,76
Trnava region	17	75096	0,23	16	72661	0,22
Trenčín region	2	76084	0,03	8	72801	0,11
Nitra region	33	87788	0,38	26	84546	0,31
Žilina region	41	97596	0,42	39	94740	0,41
Banská Bystrica region	24	81133	0,30	25	78193	0,32
Prešov region	8	117039	0,07	8	114403	0,07
Košice region	144	106865	1,35	94	104206	0,90

Table 5: Graduates of doctoral studies in science, technology, engineering and mathematics (STEM) per 1,000 inhabitants aged 25-34 years (%). Source: VAIA (2024)

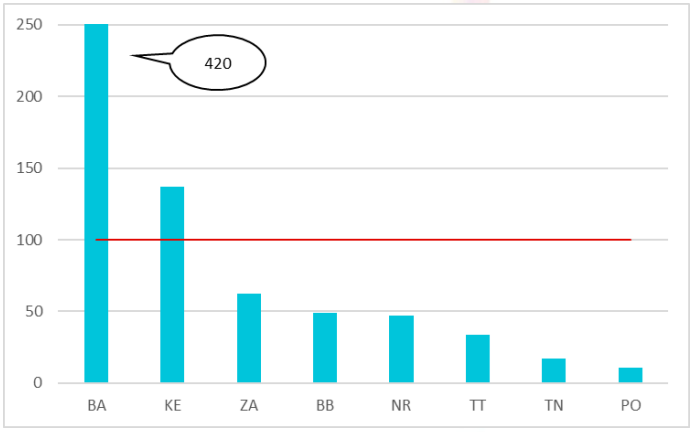


Figure 12: Graduates of doctoral studies in science, technology, engineering and mathematics (STEM) per 1,000 inhabitants aged 25-34 years (%). Source: VAIA (2024)

Innovators

The highest percentage of SMEs introducing product innovations we have recorded in Bratislava region, Žilina region and Banská Bystrica region (Table 6).

	2021	2022
SR total	14,10	15,28
Bratislava region	17,66	19,48
Trnava region	10,62	13,74
Trenčín region	10,62	13,74
Nitra region	10,62	13,74
Žilina region	16,39	14,46
Banská Bystrica region	16,39	14,46
Prešov region	13,93	13,22
Košice region	13,93	13,22

Table 6: SMEs introducing product innovations (percentage of SMEs). Source: VAIA (2024)

The highest percentage of SMEs introducing product innovations was recorded in Bratislava region (Table 7 and Figure 13).

	2021	2022
SR spolu	26,06	24,18
Bratislava region	32,07	29,73
Trnava region	21,25	22,35
Trenčín region	21,25	22,35
Nitra region	21,25	22,35
Žilina region	30,65	23,41
Banská Bystrica region	30,65	23,41
Prešov region	22,80	20,68
Košice region	22,80	20,68

Table 7: SMEs introducing business process innovation (percentage of SMEs). Source: VAIA (2024)

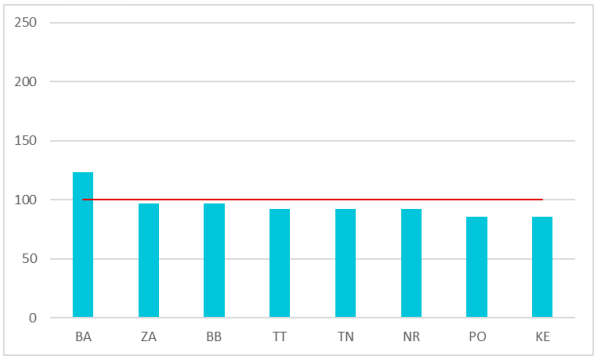


Figure 13: SMEs introducing business process innovation (percentage of SMEs). Source: VAIA (2024)

In summary, the Bratislava Region is by far the most innovative region in Slovakia, the largest year-on-year the change was noted by the Banská Bystrica region. The leading position of the capital compared to other regions is typical also in other European countries. The Bratislava region is at first place in 16 out of 24 indicators. It is in almost all of them above the Slovak average. The Banská Bystrica region is the jumper of the year, mainly thanks to top scientists publications, ICT employees and a significant improvement in industry emissions. The region thus managed to jump from 7th place in 2021 to 3rd place in 2022 [118].

2.2 Legislative Frameworks

The legislative environment must be supportive of TT.

In some cases, there are differences in national legal systems, in Innovation laws, unequal geographic presence of TTO, or "black holes" in European research territories.

In this section, explain the current legal situation of TT (the laws or the main law) and its main characteristics, barriers or "black holes". Also give an overview about regional differences (if they existed).

Do HEIs (universities) and technological centers have internal regulations?

Are there any recent regulatory changes? What is their impact?

According to the survey provided between TTC and other stakeholders in Slovak ecosystem of TT, mostly the stakeholders have agreed that the current legislative framework in Slovakia does not provide sufficient support for TT. HEIs (universities) and technological centers have internal regulations, e.g. Slovak University of Technology, Comenius University Bratislava, Pavol Jozef Šafárik University in Košice, Technical University of Košice, University of Žilina, Technical University in Zvolen.

Dealing with intellectual property subjects created at public universities, especially transfer of them, is not common in Slovakia, which is visible also in not satisfying legislative environment where the transfer happens. Questionable however is if little number of transfers results from absent legislation or, in the contrary, if missing legislation is an obstacle for intellectual property

rights transfer to become more popular in academic environment. Initiatives to change legislation in this field take place for a longer time but still without more significant positive result [10].

After reviewing the relevant legislation and statutes, no university or Slovak Academy of Science (SAS) has created the conditions for its internal regulations in the area of technology transfer and intellectual property to be normatively binding on senior employees (managers), faculties, organizations and organizational units [43].

Identified were several legislative obstacles to the effective transfer of technologies, both in relation to universities and SAS and its institutes, respectively centers. Above all, was found that in the current law there are several fundamental "blockers" in the handling of intellectual property and in the establishment of new entities (e.g. spin-off companies) by state universities and SAS organizations. Also was found that although the law does not explicitly limit public universities in handling their intellectual property, it also does not give them even basic conditions and restrictions aimed at creating "good practice" in this area. Universities will find detailed instructions in the law on how to proceed when renting their real estate, but the law does not help them in any way in some key stages of technology transfer (including dealing with intellectual property). This is especially true in connection with the so-called by direct technology transfer, which appears to be the most suitable concept for connecting university science and technology with economic practice. It is difficult to rely only on the internal regulations of individual universities, or to model directives published on the National Portal for Technology Transfer. The degree of legal uncertainty of the participating entities is too high [44].

The legal framework needs to be revised in order to establish clear and binding rules in relation to all forms of IPR protection, with an emphasis on transparency and ownership. The new rules must ensure that sensitive information is effectively protected as it comes into the public domain by being made public [116].

An **overview of the basic legal regulations** in the field of intellectual property protection, with a brief description:

- **Act on Personal Data Protection and Amendments to Certain Acts** 122/2013 Coll. effective from 15/04/2014 (updated 12/08/2016)
- **Act on Patents, Additional Protection Certificates and Amendments to Certain Acts (Patent Act)** effective from 1 July 2016 435/2001 Coll. (updated 12/08/2016)
- **Decree of the Office of Industrial Property of the Slovak Republic no. 223/2002 Coll., which implements Act No. 435/2001 Coll. on patents, supplementary protection certificates and on the amendment of certain laws**, effective from 1 July 2002 (updated 12 August 2016)
- **Act on Utility Models and Amendments to Certain Acts** 517/2007 Coll. effective from 1/7/2016 (updated 12/8/2016)
- **Decree of the Office of Industrial Property of the Slovak Republic** no. 1/2008 Coll., implementing Act No. 517/2007 Coll. on utility models and on the amendment of certain laws, effective from 1 February 2008 (updated 15 August 2016)
- **Trademark Act** 506/2009 Coll. effective from 1/7/2016 (updated 12/8/2016)
- **Decree of the Office of Industrial Property of the Slovak Republic** no. 567/2009 Coll., implementing Act No. 506/2009 Coll. on trademarks effective from 1/1/2010 (updated 8/12/2016) [56].

Positive effects of recent legislative changes:

- Today's legal situation is also significantly more favorable and suitable, probably not only for the commercialization of intellectual property.
- The transition to the public research institutions regime (in case of Slovak Academy of Sciences) removed the most fundamental, principled legislative obstacles, in particular the impossibility of licensing or transferring intellectual property [43].
- New legislative changes will remove fundamental legislative obstacles that have long prevented innovative state and public institutions from handling intangible research and development results, especially intellectual property.

Negative effects of recent legislative changes are follows:

- Rigid legislative, administrative and financial rules at the national level, hindering cooperation between the business sector and universities in transferring knowledge into practice
- In current law, there are several fundamental "blockers" in the handling of intellectual property and in the establishment of new entities (e.g. spin-off companies) by state universities and Slovak Academy of Sciences organizations.
- Although the law does not explicitly restrict public universities in the handling of their intellectual property, it does not give them even basic conditions and restrictions aimed at creating "good practice" in this area.
- The law does not help universities in any way in some key stages of technology transfer (including the handling of intellectual property) [39].
- Legislative norms, and in particular the way in which universities are funded, partially restrict the freedom of action of universities in relation to the transfer of knowledge and technology into practice.

3. Strategy for TT

TTO and TT managers must have a coherent strategy for growth. In this section, each PP should analyse whether there is a strategy defined in the country according to the different interviews carried out.

- *Is there a national strategic plan?*
- *What are its main characteristics?*

Specifically, if there is a defined strategy at the state level and also at the level of the different centers.

Slovakia aims to get closer to other European countries in the area of innovation and technology transfer into practice.

Until now, Slovakia has no national strategic plan for TT. Despite the absence of the national strategy for TT, the Slovak Government has approved in 2023 the National Strategy for Research, Development and Innovation until 2030 [118]. The strategy is a vision and plan for how to increase the competitiveness of the economy and the quality of life by means of innovations and reforms in the field of research, innovation and talent. With this step, the government fulfilled another of

the milestones from the Recovery Plan and at the same time committed to give 1 billion EUR per year from the budget to research, development and innovation until 2030.

In the strategy, the Government of the Slovak Republic is committed to supporting professional technology transfer in public scientific research institutions.

The strategy assumes that scientific research institutions will actively develop steps to support the functioning of professional workplaces for technology transfer, or to establish them directly at the institution, if they have not yet been established. For such workplaces, the strategy assumes that they will have delegated centralized competence to deal with the assets of the entire institution in the form of created industrial property.

The strategy states the provision of the so-called minimum standard for handling intellectual property created from public resources. It will be a set of organizational and procedural measures, the implementation of which on the ground of academic institutions will ensure the handling of the created intellectual property with due professional care and in the spirit of the best known practice. Fulfilment of the minimum standard will be objectively and transparently verifiable. In order to define, verify compliance and help with the implementation of processes and organizational measures according to the minimum standard on the ground of academic institutions, the strategy assumes the establishment of an authority. The minimum standard will relate to the incorporation of the required procedures in the technology transfer process in the internal guidelines of the institutions, ensuring the availability of professional care for the created intellectual property to the minimum required extent through its own specialized workplace for technology transfer or through the provision of external supplies, it will also require the fulfilment of the minimum professional and expert levels at specialized workplaces for TT, will contain requirements for the innovation management system, including, for example, the publication of an updated portfolio of offered solutions and scientific-research competencies for technology transfer.

Another measure is the training of experts in the field of technological and knowledge transfer and innovation management thanks to the introduction of a study program focused on these areas. The Slovak government expects active cooperation from Patent Information Center PATLIB at CVTI SR.

Open Access is a topic that has been resonating in the field of technology transfer for some time. The government has committed to create a new action plan for open science, which will respond to international developments (mandatory open access publishing, which is in Horizon Europe), which seeks to change publishing standards on a global scale. The measure is intended to contribute to the expansion of publishing in the open science regime, including the publication of research data. On the other hand, however, attention must be paid to ensure that this approach does not negatively affect the process of intellectual property protection, which will arise on the ground of scientific research institutions.

According to the adopted strategy, the financing of universities and Slovak Academy of Science is also to undergo a change. This should grow naturally in order for Slovak universities to be competitive as employers as well. Funding of scientific research institutions will reflect the results of the verification of the impact of the activities of academic institutions using the VER (Verification of Excellent in Research) methodology. The quality indicators of the outputs will be adjusted, which will move to the AIS (Article Influence Score) - to the most cited publications. In the case of intellectual property rights, it is proposed to shift the criteria from filing an application

to a granted patent, preferably a foreign one. The joint outputs of several research and development organizations will be evaluated in order to support the mutual cooperation of the organizations. Performance contracts will be signed with all universities and SAS, which will have set criteria supporting educational outputs, research outputs as well as social impact. Institutions will be rewarded for progress in quantitative indicators (in the results of research, education and cooperation with practice), but also for the introduction of important qualitative systematic changes [28].

Part of the recently adopted National Strategy for Research, Development and Innovation 2030 also includes the protection of research results created at Slovak scientific institutions and their subsequent commercialization and use in practice [52].

The main theme of the strategy is how to bring research, development and innovation, in which Slovakia currently lags behind, to a competitive level. An integral part of progress in this direction is the necessity to protect, commercialize and implement the results of research and development - intellectual activity. With this strategy, the government attaches indisputable importance to technology transfer in Slovak scientific and research institutions and has prepared specific steps to support it.

In the strategy, the Government of the Slovak Republic is committed to supporting professional technology transfer in public scientific research institutions.

The strategy assumes that scientific research institutions will actively develop steps to support the functioning of professional workplaces for technology transfer, or to establish them directly at the institution, if they have not yet been established. For such workplaces, the strategy assumes that they will have delegated centralized competence to deal with the assets of the entire institution in the form of created industrial property.

The strategy states the provision of the so-called minimum standard for handling intellectual property created from public resources. It will be a set of organizational and procedural measures, the implementation of which on the ground of academic institutions will ensure the handling of the created intellectual property with due professional care and in the spirit of the best known practice. Fulfilment of the minimum standard will be objectively and transparently verifiable. In order to define, verify compliance and help with the implementation of processes and organizational measures according to the minimum standard on the ground of academic institutions, the strategy assumes the establishment of an authority. The minimum standard will relate to the incorporation of the required procedures in the technology transfer process in the internal guidelines of the institutions, ensuring the availability of professional care for the created intellectual property to the minimum required extent through its own specialized workplace for technology transfer or through the provision of external supplies, it will also require the fulfilment of the minimum professional and expert levels at specialized workplaces for TT, will contain requirements for the innovation management system, including, for example, the publication of an updated portfolio of offered solutions and scientific-research competencies for technology transfer.

Another measure is the training of experts in the field of technological and knowledge transfer and innovation management thanks to the introduction of a study program focused on these areas. The Slovak government expects active cooperation from our organization.

In the case of intellectual property rights, it is proposed to shift the criteria from filing an application to a granted patent, preferably a foreign one. The joint outputs of several research and

development organizations will be evaluated in order to support the mutual cooperation of the organizations. Performance contracts will be signed with all universities and SAS, which will have set criteria supporting educational outputs, research outputs as well as social impact. Institutions will be rewarded for progress in quantitative indicators (in the results of research, education and cooperation with practice), but also for the introduction of important qualitative systematic changes [58].

According to our survey [91], CTT STU in Bratislava has a clearly defined strategy to support TT. Other TTCs does not have a clearly defined strategy to support TT or neither agree nor disagree with a clearly defined strategy to support TT.

3.1 Global strategy of HEIs in TT

Describe:

- *How important is TT in HEIs?*
- *Is there a clearly defined strategy in HEIs in respect of TT?*
- *Are HEIs government teams involved in the strategy?*
- *Do innovative companies have an equally defined strategy?*

In the knowledge economy, innovation is the main source of value for public and private organizations. The increasing importance of knowledge and technology is clear, since innovative products and services based on new knowledge are those that enjoy the best chance of success in the market. Around the world - and especially in developing countries - the main generator of knowledge and technologies are HEIs. Their role has been changing rapidly the further we advance in the so-called era of knowledge and they have become important allies for companies, public entities and associative organizations in carrying out innovation processes based on the use of research results.

Knowledge and technology transfer (KTT) undertaken in HEIs seeks to increase the impact of the research carried out by teaching and research staff through joint university-external actor actions and the commercialization of intellectual property, seeking to benefit external, public and private organizations [49].

Accordingly, several studies have focused not only on the traditional university's goals of teaching and research but also on the third mission of knowledge transfer (KT). KT is a complex and rapidly evolving phenomenon based on the interactions of several stakeholders. Universities may address various objectives through KT activities, such as providing services to faculty, enhancing innovation and the practical use of research results, generating additional income streams, fostering local economic devel- opment, complying with national and institutional policies, and pro-moting public value.

However, despite the general claims of the importance of university administrators' adopting a strategic perspective in the field of KT, we still know very little about strategic-goal setting in this area and, in particular, how it should match an institution's unique characteristics. Since universities differ along various dimensions, including the pool of available resources, the scale and focus of their research efforts, and the level of experience in technology licensing, patenting and spin-offs, it is likely that they would not adopt a single style for KT [29].

3.2 Map of Stakeholders

Identify the main actors (agents) in the national ecosystem interested in TT (HEIs, research centers, technology center, government, startups/spinoff and business sector).

- *Identify the main (most active/discovered) entities.*
- *Quantify approximately the number of HEIs, technology centres, research centres, companies that invest in R&D&I.*
- *Identify the main sectors of research, research and innovation.*

For successful technology transfer, universities and research institutions need to operate in an effective innovation ecosystem – an interconnected network of governmental, industry and research institutions and enabling factors (such as human capital, technology transfer structures, and sophistication of businesses and market). In such an ecosystem, the parties bring their resources and expertise together to collaboratively achieve innovation in the service of regional and economic development [125].

In a technology transfer ecosystem, key stakeholders play crucial roles in facilitating knowledge dissemination and innovation. These stakeholders include academia, industry, government and various support actors within the ecosystem.

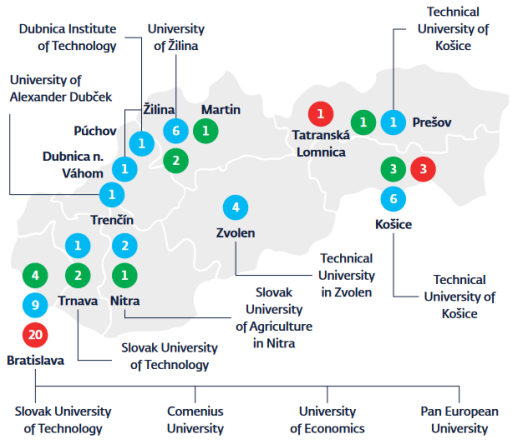
Within the university or research institution, the main technology transfer actors are the research staff and the technology transfer professionals (TTPs) [124].

Technology transfer results from actions taken by various actors in the Slovak ecosystem including HEIs, research centers, technology centers, government, startups/spinoffs and business sector. The national innovation system represents a complex of relationships that arise between individual actors, whose function is to enable technological development and innovation in various fields.

The **academic field of Slovak ecosystem in TT** is represented by HEIs – *Slovak University of Technology in Bratislava, Comenius University in Bratislava, Technical University of Košice, Pavol Jozef Šafárik University in Košice, University of Žilina, Technical University in Zvolen, Slovak University of Agriculture in Nitra,* and others.

On the Map 1 we can see the geographical distribution of Slovak universities. Numbers in the map correspond with the number of technical/ICT faculties, university science parks & technical research institutes of the Slovak Academy of Sciences in respective cities.

The public R&D infrastructure in Slovakia constists of highly competitive technical faculties at universities located all around the country, as well as of a wide network of institutes of the Slovak Academy of Sciences. Strong cooperation partnerships of both local and foreign companies, universities and research institutions is characteristic for Slovak R&D ecosystem [72].



Map 1: Slovak universities. Source: SARIO (2024)

Slovak university system

Higher education institutions (HEIs) are third-level education, scientific and art institutions. The major task of HEIs is to provide higher education and scientific research or creative artistic activity.

Based on founding and funding there are 3 types of HEIs:

1. Public Higher Education Institutions are established by law. They are funded mostly by the government. They are statutory and self-governing institutions. At present, there are 20 public HEIs in Slovakia, comprising of 9 more or less traditional universities, 5 universities of technology, 3 HEIs of art and music, 1 university of economics, 1 university of veterinary medicine and pharmacy and 1 university of agriculture.

2. State Higher Education Institutions (3 HEIs) are military, police and medical schools. They are established by law and governed by the state through the respective ministries of the government. The state HEIs are fully funded from the state budget.

3. Private Higher Education Institutions (11 HEIs) need state approval issued by the Government of the Slovak Republic. They are established and funded by non-governmental institutions or founders. Most of the private HEIs provide education in the fields of economics, business, management, public administration, law, international relations, regional development, medical and social work.

HEIs can be divided into organisational units, i.e. faculty (a self-governing unit with a higher level of autonomy), institute (governed by the respective HEI or faculty, mostly comprising more departments) and department.

Also, foreign HEIs established and situated in the territory of another member state of the European Union may provide higher education following the law of their country of origin in the territory of Slovakia once they have been granted official approval by the Ministry of Education, Research, Development and Youth of the Slovak Republic [70].

According the interantional comparison, QS World University Rankings 2023 included only 6 Slovak universities in the ranking, which includes the top 1,500 universities from around the world, Comenius University in Bratislava, Pavol Jozef Šafárik University in Košice, Slovak University of Technology in Bratislava, University of Žilina and Slovak University of Agriculture in Nitra.

The most active universities in case of TT in Slovakia are: Slovak University of Technology in Bratislava, Comenius University Bratislava, Technical University of Košice, Pavol Jozef Šafárik University in Košice, University of Žilina, Technical University in Zvolen, Slovak University of Agriculture in Nitra.

Essential part of ecosystem are Technology Transfer Centres (TTC). Slovak universities have established their TTCs, e.g. Technology Transfer Office (TTO) at STU, Technology Transfer Centre Comenius University (CTT UK), Center for Technology Transfer (CTT UPJŠ), AgroBioTech Transfer Centre of SPU, Technology Transfer Center Žilina, Department of Technology Transfer in Zvolen (RTT TUZVO), etc.

Other imporant parts of ecosystem are represented by science parks and research centres.

Almost 400 million EUR has already been invested in the infrastructure of science parks and research centers in Slovakia [59].

We have identified following main actors in the Slovak ecosystem interested in TT (Table 8).

HEIs	Research centres	Science parks	TT centres	Government	Startup/ spinoff	Business sector
	Biomedical Center Martin	Martin Centre for Biomedicine (BioMed Martin)	TTC at the Slovak Centre of Scientific and Technical Information			
Slovak University of Technology in Bratislava		University Science Park at the Slovak University of Technology (Bratislava)	Technology Transfer Office (TTO) at STU	Research and Innovation Authority (VAIA)	STUVITAL, IVMA STU, SMME STU, Hydrotechnika STU, ENFEI, UXtweak	IBM
Comenius University Bratislava		Comenius University in Bratislava Science Park	Technology Transfer Centre Comenius University			
Technical University of Košice	UVP TECHNICOM	University Science Park TECHNICOM (Košice)	UVP TECHNICOM	Ministry of Education, Research, Development and Youth of Slovak Republic		GlobalLogic Slovakia
Pavol Jozef Šafárik University in Košice		University Biomedical Science and Technology Park in Košice	Center for Technology Transfer (CTT UPJŠ)	Ministry of Economy of the Slovak Republic	Saftra Photonics	
Technical University in Zvolen			Department of Technology Transfer (RTT TUZVO)	Industrial Property Office of Slovak Republic		
		University Science Park for Biomedicine (Bratislava) University Science Park CAMBO	Technology Transfer Office of Slovak Academy of Science (KTT SAV)			
Slovak University of Agriculture in Nitra	AgroBioTech Research Centre		AgroBioTech Transfer Centre of SPU			
University of Žilina	Research Centre of the University of Žilina	University Science park of the University of Žilina				

Table 8: Main actors in the national ecosystem interested in TT in Slovakia. Source: own elaboration

To quantify the number of TTCs in Slovakia, there is 10 technology transfer centres. The number of science parks is 7 [37].

Science parks

Science and technology parks (STP) are territories usually affiliated with a university or a research institution, which accommodate and foster the growth of companies based therein through technology transfer and open innovation [126].

Science parks play an important role in the process of innovation, development of new technologies.

The main role of science parks is to support leading applied research and enable the transfer of knowledge from the academia to the economic and social practice through technology transfer (licenses, spin-offs or other forms of knowledge processing). From this point of view, science parks are complex units that:

- focus on the systematic development of the key science and research institutions in the region;
- integrate the research infrastructure into a larger entity and have a network of unique modern research equipment, laboratories and departments;
- provide opportunities for the acceleration of ideas and for the incubation of innovative companies through applied research: they facilitate the creation and accelerate the growth of new businesses through incubation and spin-off mechanisms;
- have high-quality, effective scientific management, based on relevant experience from prominent science parks, which guarantees the quality management and sustainability of the university science park;
- in addition to research and development support, they also provide a growth impulse to the region.s and technology transfer.

A wide range of effects have been generated by the science parks and centres. Unique state-of-the-art technologies have been made available to a wide range of target groups, such as researchers and students. As a consequence, the number of researchers in Slovakia is expected to double over the next five years, but this depends on the upgrading of the broadly defined ‘environment,’ as well as on the boosting of cooperation between variety stakeholders. Finally, parks and centres have reduced the brain drain from regional public R&D organisations.

All the parks and centres conduct a broad range of activities, principally R&D projects together with universities/SAS and enterprises. In addition, they carry out limited visits to businesses and provide specific consulting services. Moreover, they cooperate with various public organisations in the field of economic and innovation development.

Nevertheless, achieving the main mission has been thwarted due to the conditions set in relation to revenue generation. Collaboration with businesses has been hindered because of the choice of highest support intensity, which includes a state-aid regulatory element. In reality, some of the projects—under certain conditions—simply could not generate revenue, which in effect meant that genuine collaboration with industry was not possible.

This has significantly affected the ability of science parks and centres to fully meet the original objectives. This regulatory constraint defined in the calls has hindered activities with links to the real economy, as well as cooperation with industry in general [3].

Supported parks and centers have been built disproportionately in terms of regional funding distribution as well as the number of projects. The most intensive intervention was directed to Bratislava, Košice and Žilina self-governing regions with the highest concentration of the R&D facilities. The highest portion of ESIF was focused on building of new facilities and respectively renovation of old ones. Additionally, more that half-portion of the overall funding was intended to reduce technological gap – new equipment and technologies were purchased University science parks represents a key element of the technology transfer and innovation ecosystem in Slovakia. All supported science parks and technology centers are fully compatible with the priority areas identified under national smart specialization strategy (RIS-3 SK) [2].

Until now, 7 science parks have been established in Slovakia: The University Science Park for Biomedicine (Bratislava); the Comenius University in Bratislava Science Park; the University Biomedical Science and Technology Park in Košice (MediPark); the University Science park of the University of Žilina; the University Science Park TECHNICOM (Košice); the University Science Park at the Slovak University of Technology (Bratislava); and the University Science Park CAMBO (Trnava).

Research Centers

Also, 5 research centers were established in Slovakia: the *Biomedical Center Martin*; the *AgroBioTech Research Centre* (Nitra); the *Research Centre of the University of Žilina*; the *Centre for Applied Research of New Materials and Technology Transfer* (Bratislava); and the *Research Centre for Progressive Materials and Technologies for Present and Future Applications "PROMATECH"* (Košice).

In the context of public research and development institutions, the established science parks and research centers represent a significant institutional innovation in the area of applied research and development, and are considered a national strategic R&D infrastructure, which has the potential to increase the innovative performance of the Slovak economy [38].

University Science Parks

The following university science parks, research centres and centres of excellence rank among the most important research infrastructures in the Slovak Republic, whose detailed specification, focus, selected top infrastructure, as well as development tendencies, are specified in more detail in the material: "SK Roadmap" [127].

- University Science Park STU Bratislava
- Comenius University, University Science Park in Bratislava
- University Science Park for Biomedicine Bratislava
- Medical University Science Park in Košice (MediPark, Košice)
- University Science Park "CAMPUS MTF STU" – CAMBO
- University Science Park of the University of Žilina

- TECHNICOM University Science Park for innovative applications with support knowledge technologies
- ALLEGRO Research Centre
- Centre for Applied Research in New Materials and Technology Transfer
- Research Centre for Advanced Materials and Technologies for Contemporary and future "PROMATECH" applications
- AgroBioTech Research Centre
- Research Centre of the University of Žilina in Žilina
- Martin Centre for Biomedicine (BioMed Martin)
- Centre for research and development of immunologically active substances
- Centre of Excellence for NPPC Animal Genetic Resources Research
- Centre of Excellence for Contaminants and Microorganisms in Food
- National Gene Bank of the Slovak Republic
- Centre of Excellence of the LignoSilva forestry and timber complex

University Science Park for Biomedicine (Bratislava) was established thanks to the money drawn from EU structural funds. This BioMedPark, as it is termed among the academic scholars, is unique. Its area comprises more than 18 000 square meters. It means it is a space designed for more than 500 employees from the different science institutes and other institutions cooperating with university partners. BioMedPark covers many research interest areas. The idea originated during the programming period 2007-2013. The new University Park will make use of the existing equipment infrastructure and, especially, the concentration of human research potential. Scientific research includes three areas of research; basic research, clinical research and translational/applied research. The connection of these three segments brings better diagnostics, using molecular-based techniques, and it leads to the development of new therapies. The University Science Park will become the workplace for scientists from the Slovak Academy of Science as well as research teams from Comenius University in Bratislava and the University of Economics in Bratislava. More than 33.6 million €, out of the total cost of the project, was drawn from EU structural funds within the framework of the Operational Programme Research and Development for Innovations. The rest of the money was drawn from the state budget" [78].

Comenius University Bratislava Science Park - the Comenius University Science Park Incubator (CUSP Incubator) was created on the 1 January 2017 as a part of the Comenius University Science Park within the second phase of the project „The University Science Park of the Comenius University in Bratislava“.

The aim of the CUSPI is through its activities:

- To contribute to the sector development through the support of innovative ideas and to the startups and spin-offs arise and development on the regional as well as on the international level especially in areas:
  - biomedicine,
  - biotechnology,
  - enviro-medicine,
  - bioinformatics,
  - relevant ecological innovations,

with interdisciplinary engagement of the legal, managerial and sociology consultancy.

- To support the commercialization of knowledge based on the transfer of the science and technological outputs from the university into the companies and specially into the startups and spin-offs.
- To support the connectivity with established companies through the focusing of the research and research outputs on the needs of the established companies with the aim to enhance their innovativeness and competitiveness on the market.
- To stimulate regional economic development through the supporting of innovative startups and businesses, that contribute to the job places creation and to the dynamic ecosystem development.
- To support dynamic growing companies – startups with the high grow potential.
- To create cooperation and partnership with regional and international organisations, institutions and companies with the aim to fulfil these objectives [13].

University Biomedical Science and Technology Park in Košice (MediPark) - the aim of the project "MEDIPARK, Košice" is to build a university biomedical science and technology park, which would be the top national and international centre for applied research and its transfer into practice in the field of biomedicine.

Vision is a) to integrate human potential with expertise in biomedical sciences and research infrastructure in four major institutions in Kosice – i.e. P. J. Šafárik University in Košice, University of Veterinary Medicine and Pharmacy in Košice, Technical University in Košice and Slovak Academy of Sciences, Institute of Neurobiology in Košice, b) to build the grounds for scientific interactions between academic institutions and the business sector in biomedical research and development with subsequent transfer of the acquired knowledge and innovative technologies into applications in human and veterinary medicine, pharmacy, biotechnologies and bioengineering [109].

University Science Park of the University of Žilina (USP UNIZA) was established as an excellent workplace with internationally comparable research and development outputs focused on economic growth and development of the region. The core mission of USP UNIZA is the growth of innovative culture, providing extensive support to independent research and putting knowledge into practice, regional knowledge and innovation development support, research and development in the field of intelligent transport and production systems, advanced materials and information and communication systems. USP UNIZA focuses mainly on scientific approach to solving problems applied in practice and the integration of UNIZA research activities to gain and integrate the knowledge and experience of scientists and field experts [104].

University Science Park (USP) TECHNICOM Košice - the establishment of science parks in Košice was a natural step towards innovation and technology transfer as a result of the conditions in the region - the presence of three well-known universities in the municipality and a strong IT industry.

The USP TECHNICOM, as an organizational unit of the Technical University of Košice, creates an ecosystem enabling more efficient acceleration of technological transfer, innovation and business support at the university. Further, it supports the implementation of applied research and development, while ensuring the transfer of research and development results into economic and social practice. The USP provides an incubation environment that enables the acceleration process for the formation and development of small and medium-sized hi-tech companies or startup and spin-off businesses.

The USP TECHNICOM is also a place where scientists and researchers get involved in commercial activities and collaborate with technology companies, thus promoting the transfer of research and development results to economic and social practice. The USP TECHNICOM focuses on applied research in multiple fields: information and communication technologies, electrical engineering, mechanical engineering, civil engineering and environmental engineering.

The USP TECHNICOM formed the ground for the emergence and development of business activities enabling business acceleration in the form of a Startup Center and Incubator. Since 2014, twice a year it has been organizing a competition of innovative ideas, involving so far over 140 innovative projects. The winners are rewarded with a six month stay at the Startup Center, which includes an accelerated training program to support the development of innovative ideas.

The startup support then continues with the incubation program in Incubator, where a business plan is created for the innovative project and ultimately a business entity is created. At this stage, USP TECHNICOM helps to obtain real financing for the development of innovative projects.

The USP TECHNICOM has become an innovative platform and interface for all regional research and industrial actors. It is home to several research and development innovation centers, established by specialized departments of TUKE, and external entities, yet also home to nearly 20 innovative startups [38].

Technical University in Zvolen (TUZVO) also introduced a project of Science Park named *ENVIRO-TECH*, which will deal with complex research of forest ecosystem, research of intelligent usage of wood as the most important renewable raw material through ecological and environmental research and research in the field of environmental and innovation management [48].

University Science Park at the Slovak University of Technology (Bratislava) is a major research and innovation hub disposing of the most modern infrastructure for scientific research in Slovakia next to the largest Slovak technology university. As an integral part of the University, USP provides a strong foundation for science and research and enables the integration of a large number of the STU labs and partners in the European Research Area (particularly Comenius University and Slovak Academy of Sciences).

Extensive investments helped to improve the quality of lab equipment and scientific instruments for various centres and research departments required by the professional research community. New centres include the uniquely equiped Centre for Nanodiagnostics of Materials (high-resolution nanodiagnostics) in Bratislava and SlovakION centre specialising in ion beams and plasma, based in Trnava.

The intention to build a science park at STU arose first in 2007. The concept became clearer after 2011 with the preparation and implementation of investment projects co-financed by EU Structural Funds.

One of the most significant milestones was the decision to integrate three separate STU campuses (one in the centre of Bratislava, one in Mlynská Dolina in Bratislava, and one in Bottova Street in Trnava) and create two University Science Parks in Bratislava and Trnava. Implementation of this phase was completed in 2015.

The STU University Science Park presently provides the latest research infrastructure to fulfil the mission of a modern technology university and is well-positioned to succeed in its integration in the European Research Area and meet the common European objectives [93].

University Science Park CAMBO (Trnava) was built as the first university science park in Slovakia. Campus MTF STU - Cambo for more than 42 million EUR in the premises of the Faculty of Materials Technology of STU in Trnava.

The science park was built by the end of June 2015 and have been paid for from European funds under the Research and Development Operational Program [32].

Technology and Innovation Park (TIP) UPJŠ in Košice is the centre of scientific and technological excellence at UPJŠ in Košice in the fields of biomedicine, biotechnology, information technologies, and advanced materials. The main mission of TIP – UPJŠ is the construction of a high-quality centre of capitalized research and applications, with an efficiently working environment for business activities in the high-tech industry [111].

Intellectual property protection and transfer activities at the UPJŠ in Košice are realized through the Center for Technology Transfer (CTT) (formerly the Department for Transfer of Research and Know-how Results into Practice), which operates within the UPJŠ Technology and Innovation Park (TIP UPJŠ). CTT has been established and fulfils university-wide tasks in the framework of technology transfer and intellectual property protection at UPJŠ. The CTT contributes to the development of the university mainly by supporting the commercialization of part of academic research, popularizing innovative strategies in science, research and education, and providing advice on intellectual property protection. The long-term goal of CTT is to coordinate activities leading to commercialization of intellectual property and know-how arising at UPJŠ in Košice. CTT ensures this goal in close cooperation with intellectual property creators working at individual faculties and other workplaces of UPJŠ, as well as in cooperation with SAFTRA s. r. o., which is a commercial entity fully owned by the University Pavol Jozef Šafárik University in Košice [112].

Technology transfer centres

Center for Technology Transfer (CTT UPJŠ) Košice

Intellectual property protection and transfer activities at UPJŠ in Košice are implemented through the Technology Transfer Center (CTT) (formerly the Results Transfer Section research and know-how into practice), which operates within the Technological and innovative UPJŠ Park in Košice (UPJŠ TIP). CTT was established and performs university-wide tasks as part of TT and IP protection at UPJŠ. CTT contributes to the development of the university, especially by supporting the commercialization of part of academic research, helps the development of cooperation between UPJŠ and production, or commercial sector, popularizes innovative strategies in science, research and education and provides consultations in the field of intellectual property protection. The long-term goal of CTT is the coordination of activities leading to the commercialization of intellectual property and know-how arising at UPJŠ v Košice. CTT ensures this goal in close cooperation with creators of mental ownership operating at individual faculties and other workplaces of UPJŠ, as well as in cooperation with the activities of the trading company SAFTRA, which is commercial an entity fully owned by the University of Pavel Jozef Šafárik in Košice.

Main tasks of CTT are:

1. Protection and management of intellectual property (IP) of UPJŠ and its commercialization.

2. Coordination and consultancy in the establishment and operation of start-up companies at UPJŠ.
3. Coordination of TIP-UPJŠ cooperation with spin-offs and external industrial partners, advice, help, consultations, education [112].

Priorities and scope of CTT activities are:

1. Support of transfer of knowledge, technology and intellectual property of UPJŠ into practice.
2. Identification, search and coordination of resource planning for commercialization and development of intellectual property.
3. Consultation and assistance in creating spin-off and start-up companies. Incorporation of incubator for newly established companies.
4. Assistance and support in finding suitable partners from the external environment to carry out research activities with the potential to transfer research results into practice.
5. Assistance and support in the search for grant schemes and projects within the Slovak Republic and the EU for obtaining grants for the implementation of activities with potential application in applications, as well as grants for the support and start-up of spin-off and start-up companies.
6. Providing consultancy in the field of intellectual property protection.
7. Search and identification of the results of creative intellectual activity at the faculties of UPJŠ.
8. Assessing the results of creative intellectual activity and proposing appropriate forms of legal protection of intellectual property.
9. Counselling, assistance and protection of intellectual property of UPJŠ.
10. Methodological activity and education in the field of intellectual property.
11. Collection of information and keeping of the Central Intellectual Property Register of UPJŠ.
12. Initial assessment of the usability of UPJŠ intellectual property and identification of suitable partners for commercialization.
13. Analysis of the possibilities of industrialization of intellectual property and finding out the degree of involvement of the creator.
14. Investigation of the possibilities of dealing with intellectual property UPJŠ, assistance and support to creators in the area of contractual relations and protection of intellectual property.
15. Presentation of the results of research and intellectual property subjects of UPJŠ to the public for the purpose of their commercialization and search for suitable partners for commercialization [112].

Technology Transfer Center (CTT), University of Žilina is the contact point for researchers and partners from practice who want to protect and apply their research and development results in practice. CTT supports in technology transfer process – transfer of research and development results into practice (evaluation of the market potential of technology, assistance in the preparation of contracts, assistance in the establishment of spin-off, startup, etc). It provides the public with basic information on the possibilities of industrial property of technological solutions, inventions, marking of goods and services, etc., within the Slovak Republic.

CTT offered following services:

1. Complex services in the field of intellectual property protection.
2. Support in contract or joint research, technology licensing and establishment of spin-off and start-up businesses.
3. Advice, consultancy and incubation of projects and ideas with innovative potential.
4. Elaboration of searches concerning the state of technology to verify the uniqueness of research, inventions, technological solutions, logos or design. Information needed for the elaboration of the search.
5. Educational and promotional activities in the field of intellectual property rights and technology transfer.

CTT cooperate with CVTI SR - cooperation includes the support for the implementation of individual steps of technology transfer and the protection of intellectual property [105].

Centre for Technology Transfer STU (CTT STU) provides advice on the protection of IP and its commercialization to STU employees or STU students.

Services provided by CTT STU:

- professional advice related to the protection of intellectual property
- mediation in the preparation of research reports and estimation of the commercial potential of intellectual property and related services
- cooperation with patent attorneys, experts for selected areas of intellectual property
- electronic filing of intellectual property applications at the Industrial Property Office of the Slovak Republic (patent applications, utility model applications, design applications, trademark applications)
- intellectual property management of STU (administration, records, monitoring)
- promotion of research and development results applicable in practice
- search for partners and cooperation from the industry, conducting negotiations/assistance in negotiations
- providing basic information in the field of intellectual property to STU students
- education of STU employees and students in the field of intellectual property [92].

Center for Technology Transfer (CTT UPJŠ) - intellectual property protection and transfer activities at UPJŠ in Košice are implemented through the Technology Transfer Center (CTT) (formerly the Results Transfer Section research and know-how into practice), which operates within the Technological and innovative UPJŠ Park in Košice (UPJŠ TIP). CTT was established and performs university-wide tasks as part of technology transfer and intellectual property protection at UPJŠ. CTT contributes to the development of the university, especially by supporting the commercialization of part of academic research, helps the development of cooperation between UPJŠ and production, or commercial sector, popularizes innovative strategies in science, research and education and provides consultations in the field of intellectual property protection. The long-term goal of CTT is the coordination of activities leading to the commercialization of intellectual property and know-how arising at UPJŠ v Košice. CTT ensures this goal in close cooperation with creators of mental ownership operating at individual faculties and other workplaces of UPJŠ, as well as in cooperation with the activities of the trading company SAFTRA, which is commercial an entity fully owned by the University of Pavel Jozef Šafárik in Košice [114].

UNIZA Center for Technology Transfer of the University of Žilina (CTT UNIZA) was established in 2015 as part of the Žilina University Science Park project University of Žilina (UVP UNIZA). His position and tasks are enshrined in an internal directive on handling intellectual property under the conditions of the University of Žilina. In a sense guidelines, CTT UNIZA is a specialized workplace of the University of Žilina, which serves to ensure the transfer of university research results to economic and social practice. The main tasks of CTT are comprehensive support for the management of DV v environment of UNIZA and the transfer of the results of education, research and development into practice. The main tasks of CTT are comprehensive support for the management of DV environment of UNIZA and the transfer of the results of education, research and development into practice [91].

Transfer Center of the Slovak University of Agriculture in Nitra (TC SUA) is a specialized workplace with a wide-ranging scope aimed at cooperation with the practice, popularization and commercialization of the results of science and research, protection of intellectual property and transfer of knowledge and education. It was established as part of a project funded by the EU Structural funds and cooperates in the application of the results of scientific research activities at the university's offices and the AgroBioTech Research Center. TC SUA provides, in particular, industrial and legal protection and commercialization of intellectual property and the implementation and coordination of further vocational training.

The Transfer Center creates the space for better interconnection of the university, research and economic practice. Its activities are aimed at supporting the transfer of knowledge, technologies and innovations from the scientific sphere to the commercial sphere, their valorisation and use in practice. It fulfils basic functions such as co-operation with the agri-food sector, popularization and commercialization of science and research results, protection of intellectual property, support for start-up and spin-off companies and international co-operation [86].

TUKE – Department of Intellectual Property Protection UVP Technicom. The intellectual property protection department provides comprehensive management and administration support intellectual property rights for the entire TUKE to the extent specified in the internal regulations/regulations that determine the procedure and rules for creation, protection and use intellectual property. The Department of Intellectual Property Protection provides professional and legal services in the area of protection and commercialization of intellectual property for the whole of TUKE, provides basic information and performs administrative activities during drafting applications for registration of the subject of industrial protection in the register maintained by the Office of Industrial Property of the Slovak Republic, maintains a register of registered subjects of industrial protection and the register of applications for registration under TUKE.

Technical University in Zvolen (TUZVO) – Department for technology transfer (RTT TUZVO) provides expert support services in the field of intellectual property protection ownership and in the field of commercialization of the subject of ownership rights in cooperation with CVTI SR and ÚPV SR. These expert services are provided by the personnel capacities employed within the framework of

the implementation of the project National infrastructure for the support of technology transfer in Slovakia – NITT SK II.

The most used forms of TT at the university was mapped through a questionnaire at the Technical University in Zvolen in 2021. The transfer of scientific knowledge into practice through the sale and licensing of industrial property rights, as well as the establishment of companies that are financially linked to the university, is not used, but almost 20 % of respondents want to devote themselves to this form in the future. Therefore, the university plans to motivate employees to establish innovative businesses, through internal marketing aimed at increasing awareness of this possibility of transferring scientific knowledge into practice. The aim of the university is to continue the survey and launch its next stage, in which we will collect input on questions related to the motivation to participate in the transfer of knowledge, as well as map what supporting and inhibiting factors creative employees feel in this area [4].

Comenius University Technology Transfer Center (CTT UK) was established in January 2013 as part of the project "Support Center of Technology Transfer of the Comenius University (UK) in Bratislava," which was co-financed from structural funds of the EU [17].

It has been an integral part of the UK Science Park since the beginning of its operation. Any employee or student of the university can contact CTT with questions regarding the handling of industrial property, which is mainly the results of research implemented at Comenius University (UK). CTT provides employees of the Comenius University in Bratislava comprehensive support in the field of protection and commercialization of industrial ownership. Part of the support is professional advice, provision of an assessment research results in terms of their suitability for transfer into practice, as well as security patent or other protection and realization of commercialization. CTT also actively contributes to setting the university's internal rules for the use of its industrial property, in the provision of consultations and in the implementation of commissioned and joint research. CTT is a specialized type of workplace whose task is to manage the handling of industrial property of the UK and to implement the technology transfer process so that the university, its workplaces and the originators of industrial property (researchers) they made a profit. CTT proceeds according to generally binding legislation, internal UK regulations (science and technology park UK statute, directive) and in terms of best practice in the field of transfer technologies [88].

Technology Transfer Office of Slovak Academy of Sciences (TTO SAV) started its activities in October 2009 at the Technology Institute – Slovak Academy of Sciences, through the EU project “Center of commercialization of knowledge and protection of IP of SAV”. The TTO SAV was officially established in October 2011. Since the TTO SAV provided its services not only to project members, but also to other SAV organizations, the TTO SAV was delimited in 2015 and became a part of the Science and research department of the Office of SAV. Since January 2020, the TTO SAV is a department incorporated under the Department of Science and Research of the Office of SAV.

Since its establishment in 2011, TTO SAV has recorded several successes in the form of granted licenses, products ready for sale to customers or samples produced in standard production conditions, granted patents abroad and in Slovakia, as well as concluded contracts. The series of

achievements also include awards obtained at trade fairs and exhibitions, as well as the award of the work of TTO SAV in the field of technology transfer.

An integral part of the work of TTO SAV is cooperation with individual participants involved in the entire process of technology transfer, which supports the successful transfer of research results into practice. TTO SAS also cooperates intensively with the CVTI SR, for example within programs such as National infrastructure for supporting technology transfer in Slovakia (NITT SK I and II), as well as through the National Technology Transfer Center of the Slovak Republic [83].

Government

At the highest level of the Slovak ecosystem in TT on the government level is *Research and Innovation Authority (VAIA)*, as a unit of the Government Office responsible for the creation and coordination of research and innovation policies with the aim of transforming Slovakia into an ambitious and innovative country. The second stage of the ecosystem is represented by relevant ministries, *Ministry of Education, Research, Development and Youth of Slovak Republic* and *Ministry of Economy of the Slovak Republic*.

Further important actor in the Slovak ecosystem is *Slovak Centre of Scientific and Technical Information* (CVTI SR), as a subsidiary organization (public body) of the Ministry of Education, Science, Research and Sport of the Slovak Republic. CVTI SR as representative of the central support of technology transfer at the national level, contributes to technology transfer by establishing infrastructural pre-conditions for technology transfer within the framework of the NITT SK national project and by supporting academic institutions (i.e. Slovak state and public universities, *Slovak Academy of Sciences* and Slovak public research institutes) via state budget support in cases where support from the EU Structural Funds is not available.

Important goverment institution the *Industrial Property Office of the Slovak Republic (ÚPV SR),* as the central body of the state administration in the field of industrial property. It performs state administration in the field of protection of patents, utility models, topographies of semiconductor products, designs, trade marks, designations of origin of products and geographical indications [35].

The mission of ÚPV SR is to grant protection of industrial property, such as inventions (patents), utility models (so-called small patents), trademarks, designs, topographies of semiconductor products, designations of origin of products, and geographical indications of products. ÚPV SR provides services and products to the public in the field of industrial-legal information and supports the development of technical creativity and its protection, education and popularization of IP [48].

The Industrial Property Office of the Slovak Republic is the central body of the state administration in the field of industrial property. It performs this task on the basis of Act No 575/2001 Coll. on the organisation of government activities and the organisation of the central state administration, as amended. It performs state administration in the field of protection of patents, utility models, topographies of semiconductor products, designs, trade marks, designations of origin of products and geographical indications. It maintains the central fund of patent and trademark documentation, makes it available to the public and acts as a specialised centre of patent information in the Slovak Republic (other centres established by the Office). It is the promoter of international treaties for the protection of industrial property to which the Slovak Republic is

bound. It supports the development of technical creativity and the protection of its results, education and popularisation in the field of intellectual property [35].

The further actor from government institutions is *Slovak Innovation and energy agency* (SIEA), which performs state tasks in the area of innovation support, monitors and evaluates innovation activities in Slovakia and proposes measures to support them. Other important members in the Slovak ecosystem are universities.

Start-ups/spin-offs

Innovate Slovakia curated a list of top Slovak **startups** to watch in 2024 based on traction, investment raised, and potential on the market. To inspire new entrepreneurs they also put together a list of "success stories" – these are Slovak tech companies that grown into mature companies with significant sales and employment or have been acquired [81].

- 3IPK – blockchain-based solutions allowing for efficient management of deep and wide supply chains. They are CASSINI Business Accelerator laureates.
- altFINS – Intuitive platform for coin screening and analysis
- BiteBerry – AI-based solution for bypassing third-party ordering services for the restaurant and food industry
- CloseRocket – B2B platform for sales talents
- CLOUDTALK – AI-powered business calling software
- Diagnose.me – Platform to connect with top medical specialists to provide a second medical opinion
- DNAERA – DNA tests to help you understand your genetic predispositions
- Excalibur – Turning your smartphone into a secure hardware token for all authentication
- Forvio – AI-optimising for your campaign spending
- Glycanostics – Deep tech company developing revolutionary painless and highly accurate cancer diagnosis. They are also an EIC Accelerator grantee.
- Luigi´s box – Intuitive site-search and product discovery for e-commerce businesses
- MATSUKO – 3D telepresence mixed reality technology
- Nettle.ai – Solutions in the field of conversational technologies
- Powerful Medical – Deep-tech company providing unique AI solutions for ECG interpretation. They are also EIC Accelerator grantee.
- Sensible Biotechnologies – Cell-based platform for the production of high-quality mRNA
- DimensionLab – Intuitive AI-powered physics simulation software
- Spinbotics – Modular Drive Units ensuring the intelligent movement of selected robotic devices
- Tachyum – Deep tech company engineering disruptive energy-efficient chips
- Vestberry – Portfolio intelligence software for venture capital
- Unimus – Faster, easier and more efficient network management
- zoniq – Finding the most profitable locations for public EV charging points

Startups in Košice region

The Startup scene in Košice region is growing and brings projects that have the potential not only for local, but also for global success, e.g. technological startups Spinbotics, CherryPeak, Heriport and NextRetreat.

- Spinbotics – a technology startup focused on robotics and automation, brings modular and customizable robotic solutions for various industries. Their main product, Spinbot, is designed to be easy integrate, affordable and efficient.
- CherryPeak – based in the Startup Campus in Košice, is technology startup that specializes in the design, development and implementation of digital products. Their portfolio includes everything from business process management to augmented reality (AR) solutions
- Heriport – winner of the first year of the prestigious accelerator Košice region Startup Factory, specializes in the digitalization f cultural and tourist experiences. This platform evables museums, galleries and tourist destinations to create interactive guides, maps and quizzes without the need for programming.
- NextRetreat – is a technology startup focused on simplifying the organization of team meetings and corporate retreats. Their platform offers a comprehensive solution for planning team trips – from choosing a destination, through booking accommodation and work spaces, to securing local services such as transfers or private chefs [34].

Spin-offs

There are various university spin-offs at the Slovak University of Technology, e.g.

- *STUVITAL*, Ltd. – to contribute comprehensively to the improvement of the situation in the field of nutrition, health and thus the quality of life of the Slovak population through scientific research, development, implementation and educational activities.
- *IVMA STU*, Ltd. – research and development in the field of natural and technical sciences, informative testing, measurement, analysis and control, services related to computer data processing.
- *SMME STU*, Ltd. – research, development and consultancy in the field of electromobility, cars and their mechatronic systems, security systems. Transferring theoretical knowledge into practice by applying modern methods of virtual prototyping, modeling and simulations.
- *Hydrotechnika STU*, Ltd. – research, development, consultancy, project and engineering activities in the field of water structures, water transport, waterways and flood protection. Research and development of software applications for the management of hydropower systems and systems. Field and laboratory research in the field of water structures.
- *ENFEI* Ltd. – the company's activities are divided into two main areas, namely the area of operation of the electricity system and the area of the smart grid.
- *UXtweak* – is a budding Slovak start-up, or a university spin-off that was created in 2019. Currently, it is a functional combination of researchers from FIIT STU and marketers from the advertising agency Elite Solutions. UXtweak is a tool that transfers user testing from UX laboratories to the online world for subjects from economic practice [94].

From other spin-offs identified during our survey at the UPJŠ Košice [108], we have identified SAFTRA Photonics, Slovak high-tech company estabilished as a spin-off from the Pavol Jozef Safarik University in Kosice in 2014.

Saftra Photonics won the 2017 Startup Awards competition with a tester for hazardous substances in water and food. The long-term research of biophysics professor Pavel Miškovský from the Pavel Jozef Šafárik University in Košice is behind the invention.

Companies that invest in R&D&I

Although Slovakia may still be considered an industrial, especially automotive superpower, the country's priority is the support of projects with higher added value and R&D activities. Slovakia has both substantial established and potential capabilities for the R&D. Innovation is being stimulated throughout the economy and sustained by both Slovak and foreign players [57].

Mainly large companies in the automotive and engineering industry invest in their own research in Slovakia [75].

On the following Map 2 we can see the geographical distribution of private R&D in Slovakia.

Map 2: Network of Private R&D Operations in Slovakia. Source: SARIO (2024)

The last part of ecosystem is represented by **support organizations, e.g. associations, clusters**, etc. Slovak Alliance for Innovation Economy (SAPIE) is an independent and non-profit platform whose mission is to empower the Slovak innovation ecosystem. It's the largest professional association representing almost 200 member companies and organizations.

The Union of Slovak Clusters (UKS) was established in 2010 as a non-profit organisation. It is the only organisation representing clusters in Slovakia. Currently, UKS has 18 members. The vision is to create a suitable and competitive business environment through the close cooperation of regional government, academia and research with business in the area of innovation.

From clusters, we can mention *Cassovia New Industry Cluster* (CNIC), the founders of which are three Košice universities – Pavol Jozef Šafárik University in Košice, Technical University in Košice and University of Veterinary Medicine and Pharmacy in Košice, the City of Košice and the Košice Self-governing region. Besides the academic sector and local government, Cassovia Discovery Park, the Slovak Academy of Sciences, and the L. Pasteur University Hospital also participate in it. The goal of the Innovation Center of the Košice Region (ICKK) and the Košice Cluster of New Industry (CNIC), which is its pilot project, is to create new jobs, support innovation, increase living standards, and thus the overall growth of the economy in the region.

SAPIE is a leading platform for policy debate on digital economy and innovation in Slovakia aspiring to unite leaders within the CEE region. It is active in forming collaborative networks of private and public actors, supporting the startup scene and community and enhancing digital transformation of SMEs within the CEE region).

CVTI SR have established *National Center for Technology Transfer of the Slovak Republic* (NCTT SR). The participants of the association, which are legal entities with a scientific research focus from the public sphere with headquarters in the territory of the Slovak Republic, joined together for the purpose of fulfilling a common goal - the systematization of support for the implementation of technology transfer (protection of intellectual property and its commercialization) of scientific research institutions of the Slovak Republic. Systematization is to be implemented through a sustainable and long-term self-financing Patent Fund and other system components to be added in the future. The association provides support to participants, and under the conditions agreed in the contract to third parties, especially in the protection of intellectual property in the process of technology transfer and in the commercial use of the results of research, development and innovations that arose as part of the scientific research activity of the Slovak academic institutions, in improving the conditions for the transfer of outputs scientific research activity into practice and the related protection of intellectual property at public scientific research institutions, while improving the legislative environment in the Slovak Republic in order to streamline the possibilities of technology transfer and mutual exchange of information on experiences in the field of technology transfer [60].

The participants of the NCTT SR association are: CVTI SR, Slovak Academy of Science, Slovak University of Agriculture in Nitra, Slovak University of Technology in Bratislava, Technıcal University of Košice, Technical University in Zvolen, Comenius University in Bratislava, Pavol Jozef Šafárik University in Košice and University of Žilina.

To quantify approximately the number of stakeholders, the number of HEIs in Slovakia 20. The number of technology transfer centres 10. The number of technology centres by the Ministry of Economy 12. The number of science parks 7. The number of companies that invest in R&D&I (Number of enterprises with innovative activity in industry and selected services 2879 in 2022) [95].

The main sectors of research, R&I: food, mechanical engineering, ecology, biology, biotechnology, medicine, transport, etc.

4 TT Structures

Having a solid and stable TT structure, as well as sufficient human and economic resources, is one of the keys to the success of TT.

- *What are the characteristics of current TT structures?*
  - *What **activities do the offices carry out** in each case (if there are different structures)? (For example, advising researchers, managing IP, marketing patents…).*
- *Which are the **services offered** in each case?*
- *Which **internal and external agents** are involved?*
  - *What are the competencies of the agents?*
- *Do they have a single TT or different office?*
  - *Are they specialized by function or by knowledge/technology?*
  - *Is it the same in all cases/ HEIs?*
- *How is developed the **communication** between different offices (within the same HEI or other HEIs), researchers and companies?*
- *What aspects should be improved? (For example, economic allocation, relevance, marketing orientation..).*

In Slovakia, technology transfer (TT) structures include:

- Technology Transfer Offices (TTO): Facilitate the commercialization of research from universities and research centres.
- Research and Development Centers: Focus on applied research and industry collaboration.
- Technology Parks and Science Parks: Provide infrastructure and support for tech startups and companies.
- Innovation Hubs and Clusters: Promote collaboration and networking among businesses, researchers, and institutions.
- Public Research Organizations: Conduct advanced research and partner with industry for technology transfer.

These structures support the transition of scientific discoveries into marketable technologies and products.

According to our survey [91], stakeholders have single TTO that offers all the services. TTC at Slovak University of Technology offers following services: Advise teachers and researchers to identify results with commercial value, Evaluate the commercial potential of the disclosed innovations, Determine whether the protection of the IP rights of the innovation, Help find industrial partners, Commercialize innovations, Negotiate licence agreements for the transfer of innovation IP rights, Administrative functions in support of the IP protection and technology transfer functions.

Areas that should be improved in TTO STU current TT structure are: Economic resources, Marketing orientation, Contact with the rest of the ecosystem (industrial companies or target audience).

Three main strengths of TTO Centre of STU TT structure are: Directive adopted, Professional employees and Large patent portfolio.

Centre for technology transfer STU provides scientists consultancy in the protection and commercialization of IP and concludes agreements with industrial partners, mediates assistance

in setting up spin-offs enterprises and looks for opportunities to provide professional consultations to industrial partners from all areas of STU research activity.

TT Services provided for STU employees are: Legal advice in the field of protection intellectual property, Intermediation of search services, Mediation of evaluation of the results of research and development at STU in terms of their commercial use, Legal support when concluding license agreements, Searching and mediation of contacts to partners from industrial practice, Active promotion of the results of research carried out at STU.

Services for companies: companies can use the research potential of STU and thus improve their product portfolio, processes, technologies and services for their clients. In addition to professional consultations, technical support and licenses, STU offers cooperation on research and development projects and the preparation of expertise [91].

In 2023, TT Office at STU has received 45 Notifications of the originator about the creation of the subject industrial property. The number of patent applications submitted to the Industrial Office owned by the Slovak Republic in 2023 was 20. The number of granted patents was 41. The number of submitted applications utility models to the Slovak Industrial Property Office in 2023 was 27. The number of registered there were 28 utility models. In 2023, a second license agreement was signed for the use of the invention, namely invention Soft active solder for ultrasonic soldering of non-metallic and metallic or of two non-metallic materials at higher application temperatures, at which together employees of MTF STU participated. Applying abroad: 2 PCT applications - Laboratory extractor for the study of kinetics impregnation processes of wood chips, preparations for welding the chassis frame railway wagon and 1 EP application Automatic beer brewing equipment [89].

SPU Nitra – Office of project and transfer activities is coordinating, methodically guide and administratively support the preparation, realization and implementation university projects financed from EU structural funds through operational programs as well as through international programs and others national schemes. In addition to the administration of international university projects and individual projects Office also provides professional advice, consultations and services in the field of technology and knowledge transfer, cooperates in the activities of the National Center for Technology Transfer of the Slovak Republic (NCTT SR) and coordinates the activities of SPU in Nitra within the international Danube Transfer Center Network (DTC).

Department of Intellectual Property Protection UVP Technicom Košice provides comprehensive management and administration support IP rights for the entire TUKE to the extent specified in the internal regulations/regulations that determine the procedure and rules for creation, protection and use intellectual property. The Department of Intellectual Property Protection provides professional and legal services in the area of protection and commercialization of intellectual property for the whole of TUKE, provides basic information and performs administrative activities during drafting applications for registration of the subject of industrial protection in the register maintained by the Office of Industrial Property of the Slovak Republic, maintains a register of registered subjects of industrial protection and the register of applications for registration under TUKE.

According to our survey [79], the structure of technology transfer (TT) at the Technical University of Košice (TUKE) is ensured mainly through the Technicom University Science Park. Technicom provides a platform to support collaboration between academia and industry partners. The services it provides include:

- Advising researchers in identifying and protecting commercially valuable innovations.
- Evaluating the commercial potential of research results and deciding on the protection of intellectual property.
- Help in finding industrial partners and support in the field of commercialization of research, including negotiation of license agreements and establishment of spin-off companies.
- The entities involved include the vice-rector for innovation and technology transfer, specialized teams within Technicom, and collaborating university faculties and departments.

Services covered by the Technicom University Science Park TT structure are:

- Advising teachers and researchers in identifying commercially valuable results.
- Evaluation of the commercial potential of published innovations.
- Deciding whether to protect IP rights to an innovation.
- Help in finding industrial partners.
- Commercialization of innovations.
- Negotiation of license agreements for the transfer of intellectual property rights in the field of innovation.
- Performing administrative functions to support IP protection and technology transfer.
- Advice on the establishment and management of spin-offs

In case of aspects of current TT structure at UVP Technicom that require improvement, there are: economic resources, relevance, training of participating workers, marketing orientation and contact with the rest of the ecosystem (industrial enterprises or target group).

TUZVO Zvolen – Department for Technology Transfer provides expert support services in the field of intellectual property protection ownership and in the field of commercialization of the subject of ownership rights in cooperation with CVTI SR and Industrial Property Office of the Slovak Republic. These expert services are provided by the personnel capacities employed within the framework of the implementation of the project National infrastructure for the support of technology transfer in Slovakia – NITT SK II. [97].

According to our survey [98], services covered by TUZVO TT structure are:

- Advice for teachers and researchers in the identification of commercial valuable results.
- Deciding whether to protect IP rights to an innovation.
- Help in finding industrial partners.
- Negotiation of license agreements for the transfer of IP rights in the field of innovation.
- Performing administrative functions to support the protection of IP and technology transfer.
- Advice on the establishment and management of spin-offs.

Aspects of current TT structure at TUZVO that need improvement are: economic resources, marketing orientation, contact with the rest of the ecosystem (industrial companies or target audience).

Technology Transfer Center Comenius University (CTT UK) Bratislava provides employees of the Comenius University in Bratislava comprehensive support in the field of protection and commercialization of industrial ownership. Part of the support is professional advice, provision of

an assessment research results in terms of their suitability for transfer into practice, as well as security patent or other protection and realization of commercialization. CTT UK also actively contributes to setting the university's internal rules for the use of its industrial property, in the provision of consultations and in the implementation of commissioned and joint research research. CTT UK is a specialized type of workplace whose task is to manage the handling of industrial property of the UK and to implement the technology transfer process so that the university, its workplaces and the originators of industrial property (researchers) they made a profit. CTT UK proceeds according to generally binding legislation, internal UK regulations (VTP CU statute, directive) and in terms of best practice in the field of transfer technologies.

Based on our survey [14], CTT UK is a university-wide workplace that ensures handling of UP at Comenius University. These activities include ensuring the protection of IP, but also the commercialization of IP. In addition, CTT UK provide consulting services in the field of IP protection. These activities include identification of Subject of Industrial Property, state-of-the-art research, evaluation of the commercial potential of Subject of Industrial Property, filing of patent or other applications, addressing potential interested parties in technologies, conducting negotiations and coordinating processes related to technology transfer within the Comenius University. These activities are covered by two part-time employees of CTT UK. CTT UK in some cases uses Expert Support Services provided by CVTI SR (services of experts, e.g. patent attorneys or evaluations).

Services covered by CTT UK structure are:

- Advise teachers and researchers to identify results with commercial value
- Evaluate the commercial potential of the disclosed innovations
- Determine whether the protection of the IP rights of the innovation
- Help find industrial partners
- Commercialize innovations
- Negotiate licence agreements for the transfer of innovation IP rights
- Administrative functions in support of the IP protection and technology transfer functions
- Advise on the creation and management of spinoff

UPJŠ Technology Transfer Center Košice performs university-wide tasks as part of technology transfer and intellectual property protection at UPJŠ. CTT contributes to the development of the university, especially by supporting the commercialization of part of academic research, helps the development of cooperation between UPJŠ and production, or commercial sector, popularizes innovative strategies in science, research and education and provides consultations in the field of intellectual property protection. The long-term goal of CTT is the coordination of activities leading to the commercialization of intellectual property and know-how arising at UPJŠ v Košice. CTT ensures this goal in close cooperation with creators of mental ownership operating at individual faculties and other workplaces of UPJŠ, as well as in cooperation with the activities of the trading company SAFTRA, which is commercial an entity fully owned by the University of Pavel Jozef Šafárik in Košice.

The main mission of the University Technology and Innovation Park (TIP-UPJŠ) is to build an important European center of capitalizable education and applications, with an effectively functioning background for business activities in the high-tech industry. The task of TIP-UPJŠ in the field of technology transfer is to create a system of support for the transfer of new technologies into applications. This is primarily about complex technologies based on long-term basic

research. The goal of the entire process is the creation of successful spin-off companies that will bring to the region of Eastern Slovakia high added value and employment.

Technology transfer is the main goal of all TIP-UPJŠ activities. In 2023, an important task was the continuation of the Casstech project, activities created of the association Cassovia New Industry Cluster (CNIC) and preparation of project documentation [115].

Priorities and content of CTT activities:

- Support for the transfer of knowledge, technologies and intellectual property of UPJŠ into practice.
- Identifying, sourcing and coordinating resource planning for intellectual property commercialization and development.
- Consultations and assistance in creating spin-off and start-up companies. Support for the creation of an incubator for newly established companies.
- Help and support in finding suitable partners from the external environment to carry out research activities with the potential to transfer research results into practice.
- Help and support in searching for grant schemes and projects within Slovakia and the EU to obtain grants for the implementation of activities with the potential to be applied in applications, as well as grants for the support and start-up of spin-off and start-up companies.
- Providing consultations in the field of intellectual property protection.
- Search and identification of the results of creative mental activity at the UPJŠ faculties.
- Assessment of the results of creative intellectual activity and the proposal of appropriate forms of legal protection of intellectual property.
- Consulting, assistance and ensuring the protection of UPJŠ's intellectual property.
- Methodical activity and education in the field of intellectual property.
- Gathering information and maintaining central records of intellectual property of UPJŠ.
- Initial assessment of the usability of UPJŠ intellectual property and identification of suitable partners for commercialization.
- Analysis of the possibilities of industrialization of intellectual property and determination of the degree of involvement of the creator.
- Researching the possibilities of dealing with intellectual property of UPJŠ, help and support to creators in the field of contractual relations and protection of intellectual property.
- Presentation of research results and intellectual property objects of UPJŠ to the public for the purpose of their commercialization and search for suitable partners for commercialization.

CNIC project focus on [111]:

- biomedical research,
- progressive materials,
- green and clean technologies,
- quantum and information technologies.

According to our survey [109], services covered by CTT UPJŠ structure are:

- Determine whether the protection of the IP rights of the innovation

- Help find industrial partners
- Commercialize innovations
- Negotiate licence agreements for the transfer of innovation IP rights
- Administrative functions in support of the IP protection and technology transfer functions
- Advise on the creation and management of spin-off.

Center for Technology Transfer of the University of Žilina (CTT UNIZA) – its position and tasks are enshrined in an internal directive on handling intellectual property under the conditions of the University of Žilina. In a sense guidelines, CTT UNIZA is a specialized workplace of the University of Žilina, which serves to ensure the transfer of university research results to economic and social practice. The main tasks of CTT are comprehensive support for the management of DV v environment of UNIZA and the transfer of the results of education, research and development into practice. The main tasks of CTT are comprehensive support for the management of DV environment of UNIZA and the transfer of the results of education, research and development into practice [123].

Based on our survey [107], services covered by CTT UNIZA structure are:

- Advise teachers and researchers to identify results with commercial value
- Evaluate the commercial potential of the disclosed innovations
- Determine whether the protection of the IP rights of the innovation
- Commercialize innovations
- Negotiate licence agreements for the transfer of innovation IP rights
- Administrative functions in support of the IP protection and technology transfer functions
- Advise on the creation and management of spinoff

Aspects of current CTT UNIZA TT structure that require improvement are: economic resources, training of the personnel involved, marketing orientation.

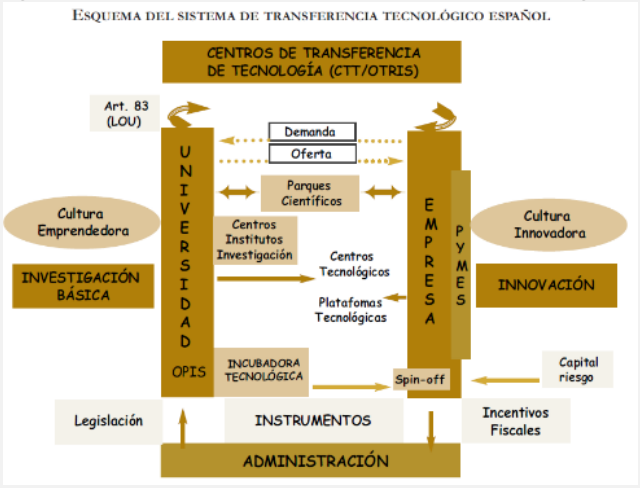
Center for Technology Transfer of Slovak Academy of Science (CTT SAV)

Started its activities in October 2009 at the Technology Institute – Slovak Academy of Sciences, through the EU project "Center of commercialization of knowledge and protection of intellectual property of SAS". The TTO SAS was officially established in October 2011. Since the TTC provided its services not only to project members, but also to other SAV organizations [83].

Some successes were achieved by SAV, which established CTT at its Institute of Technology. It was admitted to SAV that directive for the protection and commercialization of IP, and thus started the implementation of several projects. To some international patent applications (PCT) have already been filed for technologies created at SAV.

4.1 TT System Scheme

*For a better understanding, it is recommended to **draw a scheme** of TT-related agents.*



Exemple of Spain scheme

Define the function/differences related TT within:

- *HEIs (universities).*
- *Research Centers.*
- *Technological Centers.*
- *Technological Parks.*
- *Government Specific Agents.*

In the "Map of Stakeholders" section we can find the different elements that make up the technology transfer system in Slovakia. As a summary, the following Figure 14 shows the relationship between the different agents.

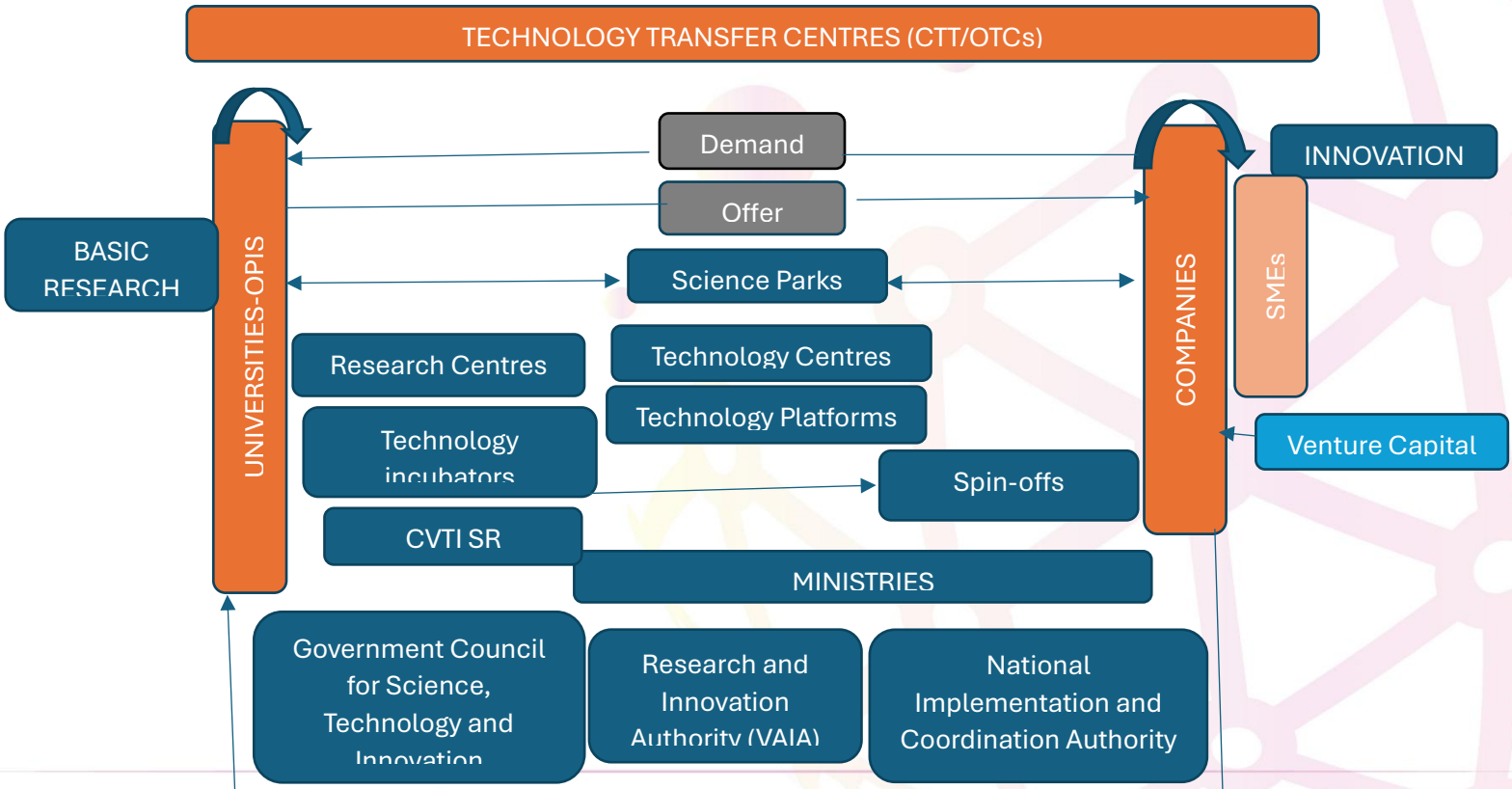


Figure 14: Scheme of TT related agents in Slovakia. Source: Own elaboration

National technology transfer support system is a system in which the participants (public universities, scientific and research institutions in Slovakia) and other participants (industry, small and medium enterprises, etc.) are provided by specific support services under clearly specified terms. Technology Transfer Centre at CVTI SR is the institution responsible for implementation of agreed terms, requirements, fulfilment of obligations and control of services provided within the framework of technology transfer [61].

The functions of each of these agents in the TT system are:

Generation of knowledge and technology:

- **Universities**: Play important role in technology transfer. On the other side, Slovak universities struggle with a lack of financial resources and, in addition, suffer from a lack of young and talented scientists, because they do not provide adequate remuneration for work and an environment for nurturing and maintaining excellence of experts. Cooperation with practice mostly takes place at the level of individual workplaces in the form of a work contract. Universities do not have sufficient financial resources to finance IP protection through patents, nor do they have the experience with the commercialization of IP [1].

- **Public research organizations:** Public research institutions are being encouraged to forge more links, notably with industry and across international borders, and "centres of excellence" have emerged strongly [57].
  In contrast to universities/colleges, public research organizations like the Slovak Academy of Science (SAV) have environment that was considerably limited in terms of commercialization possibilities due to the existing legislation. Slovak Academy of Science organizations could commercialize exclusively through licensing. As of January 1, 2022, SAV organizations changed their legal form to public research institutions. This change enables more ways to commercialize industrial property and collaborate with the private sector. This change will also bring a shift in technology transfer [76].

- **Research centres:** The projects themselves were mostly implemented as consortia projects of several organizations, which made it possible to support the networking of public R&D of organizations and the process of specialization. Example is Research center of progressive materials and technologies for current and future applications of PROMATECH, in which the Institute of Materials was involved of SAV Research, Institute of Experimental Physics SAV, Institute of Geotechnics SAV, Institute of Materials and Machine Mechanics SAS, University of Pavel Jozef Šafárik in Košice and Technical University in Košice.

- **Technology centres:** Applying the results of research and development in the economy and technological development are a necessity for increasing the added value and competitiveness of the economy of the Slovak Republic. A close connection between the academic and private sectors in development and research and increasing intelligent employment are the basic prerequisites for the fulfillment of this goal.Technological centers create space for the perfect connection of scientific and research activities with practice [51].

Agents for the connection between HEIs and companies:

- **Technology Transfer Centres:** Technology Transfer Offices (TTOs) are usually created within a university in order to manage its intellectual property (IP) assets and the transfer of knowledge and technology to industry. Sometimes, the mandate of TTOs with respect to collaborative research includes any interaction or contractual relation with the private sector. Common names for such offices differ.

- **Technology Platforms:** Technology platform is a tool supporting marketing activities undertaken at research organisations, which enables effective implementation of research results. Concurrently, it also helps one to identify actual market needs and requirements as far as innovative technologies are concerned. Within the platform, innovative product and process technologies are promoted and effective technology transfer mechanisms and structures are established and assessed [124].

- **Scientific Parks:** Science parks play an important role in the process of innovation, development of new technologies. The existing technology transfer centers at the universities were gradually transformed into built-up science parks. Science parks in the Slovak Republic were built as part of the Research and Development operational program "Building University Science Parks and Research Centers" as part of measure 4.2 Transfer of knowledge and technologies gained through research and development into practice and the Research and Development Support Scheme (State aid scheme) [37].

Business sector

- **Technology incubators:** Technology business incubators (TBIs) are organizations that help startup companies and individual entrepreneurs develop their businesses by providing a range of services, including training, brokering and financing.

- **Start-ups:** Slovak startups are concentrated in the capital. Almost 68% are registered in western Slovakia, of which 75% in Bratislava. The second city with the largest number of startups are Košice with 10%. Another three cities with an active incubator or accelerator that discovered on the map are Žilina, Banská Bystrica, Nitra. It is in other Slovak cities 11.5% of registered startups.

- **Spin-offs:** Connecting HEIs with innovative companies so that both can benefit from mutual cooperation has still has great reserves in Slovakia. There is no real possibility of

commercialization of applied research. The creation of so-called spin-offs, i.e. the transfer of research created at faculties to companies and start-ups, is still in its infancy.

Technology adoption

- **Companies:** Play a crucial role. Local and foreign companies are characteristic for Slovak R&D ecosystem.
- **SMEs:** Small-and medium-sized enterprises (SMEs) are crucial players in the innovation ecosystem. The structure of the Slovak economy is relatively weighted to micro firms and individual entrepreneurs and to large firms, particularly foreign direct investors. Between the two extremes, there is a "missing middle" of SMEs with between 10 and 249 employees, with a share well below the OECD average [62].

The role of government

The Office of the Government of the Slovak Republic through the *Research and Innovation Authority (VAIA)* is responsible for strategic and methodical coordination in R&I. Its role is to define the direction and coordination of central state administration bodies and research institutions in the field of R&I.

In order to improve the coordination of competence in the field of R&I, the Council of the Slovak Government for Science, Technology and Innovation (RVVTI) is the advisory, expert and coordinating body of the government for research and innovation policies. The *Ministry of Education, Research, Development and Youth of the Slovak Republic* (MŠVVaM SR) is responsible for most strategic documents and legislation in the field of research and development. Innovation policies are covered by the Ministry of Economy of the Slovak Republic [121].

Ministry of Finance of the Slovak Republic (MF SR): Activities of ministry has direct impact on budget creation for institutions that created policies of R&D&I, as well as by creation of tax and control policies.

4.2 TT Procedures

- *Are the HEIs responsible for TT procedures?*
- *Which types of procedures for technology transfer exists?*
- *Are they defined for all types of transfer (patents, creation of technology-based companies, contracts ...)?*
- *Which are the terms and forms of service delivery?*
- *Are the costs related to services well-defined in each case?*

Scientific institutions benefit from tailoring the TT process to meet their unique requirements. Adapting this process within each scientific institution, makes it more accessible for researchers. Acknowledging the substantial effort and resources required to manage and participate in the TT

process is essential. Acquiring knowledge necessary for each IP transfer case is a time-consuming activity, requiring robust legal frameworks to oversee the management of intellectual property rights and assist in transferring these rights to new spin-off companies. To navigate the complex legal landscape, establishing standardized processes is vital to ensure the efficient transfer of technology.

Defining the TT process for a spin-off company development involves a number of steps. Steps ensure successful progress through 3 different phases of development with the aim of technology transfer to the spin-off company: (1) research phase, (2) TT phase, and (3) Spin-off phase. Specific activities related to TT can be identified in each phase.

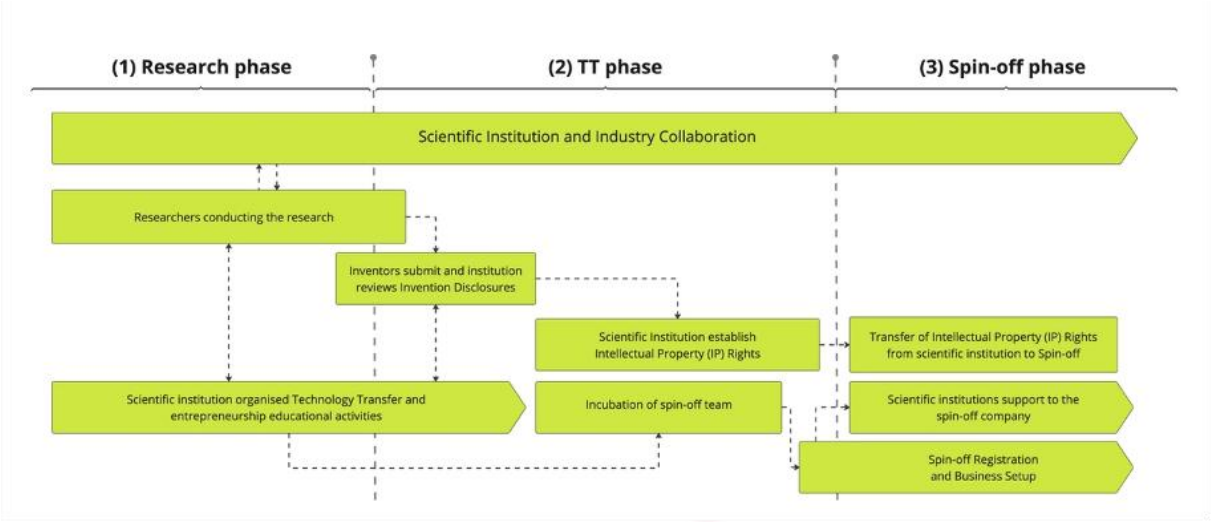


Figure 15: Phases of the Technology Transfer process. Source: Stebelis (2024)

1. Research Phase:

Apart from the research itself, the activities and characteristics of this phase are cooperation with industry and early education of researchers. Conducting the research is the core activity of the phase. Research projects are typically organized under the study process (MSc, Doctoral) or as a separate research project. Inventions are discovered because of conducted research projects.

Best practice would suggest that researchers are supported with TT and entrepreneurship educational activities. Scientific institutions with entrepreneurial mindsets facilitate different formats of initiatives to educate students and researchers about TT and its benefits from research commercialisation. It is particularly important for Ph.D. students (future researchers) to build a solid foundation about TT (for example via PhD schools). This process is highly important to engage future researchers in TT activities. Trust between researchers and the TTO is an essential element.

An even more important element to facilitate a successful TT process is the organization of scientific institutions and Industry collaboration. Scientific institutions foster industry relationships through partnerships. This long-term strategy builds a foundation for a successful TT process, facilitating alignment and trust, which results in new inventions to resolve the industry's existing and future challenges. Industry engagement is critical for the success of TT.

2. TT Phase:

The TT Phase starts with the registration of inventions. Inventors Submit Invention Disclosures. Submissions are organized and reviewed according to the Scientific institution's internal procedures and policies. In Latvia, the Law on Scientific Activity regulates the rights of the Inventor and the Scientific Institution.

Upon accepting the invention, the scientific institution initiates the process of Establishing Intellectual Property Rights. This entails preparing, reviewing, and accepting invention disclosures, conducting IP searches, assessing IP market value, drafting and filing patents or other forms of IP protection, and formulating a comprehensive IP rights strategy. Given the significant influence that the IP strategy has on business outcomes, the founding team of the spin-off company needs to be actively involved in this process.

Equally important, is the preparation of the potential business team. It is recommended that the "Incubation" of the spin-off team is organized by Scientific institutions to aid in their readiness for company creation. This process includes support for Proof Of Concept and prototyping, as well as customer discovery and market opportunity assessments, interacting with stakeholders, and developing business models. Team should be capable of reaching out to industry players to confirm that their solution solves a real problem (problem-solution fit). It's critical to understand the market early on. The goal is to create a realistic roadmap and identify the essential resources needed for the company's development. Incubation as a service can be implemented in various formats. The aim is to improve team commercial readiness.

Experience in Europe has shown that scientific institutions shouldn't rush to commercialize every technology they define as well the right timing is important. Maintaining technology IP is a resource-intensive process. As well, spin-off companies tend to have a low rate of success over the long term. Selecting best technologies and teams to support for commercialization should be well judged decision, grounded in validated information.

3. Spin-off Creation Phase:

Spin-off Creation Phase entails the Company's Registration and Business Setup. Initial team, individuals with essential competencies in business and technology, also becomes the company's founders. They must possess the necessary strength and skills to effectively pitch the business concept and secure the initial funding.

Establishing legal relationships with the scientific institution is a critical component in forming a spin-off company. This primarily involves the Transfer of Intellectual Property Rights and the provision of IP maintenance services. IP rights can be transferred through several methods, including the execution of a licensing agreement or whereby the scientific institution may become a shareholder in the spin-off company. The opinion of experts points to the participation of the scientific institution in the spin-off company through equity investments as more sustainable and profitable model. This is largely confirmed by the good examples of practice in Europe.

Even more, scientific institutions should support spin-off companies by providing access to laboratories, experts, equipment, and networking opportunities. This long-tail support creates mutually beneficial opportunities; as the spin-off company develops and grows, the scientific

institution gains access to resources through new research projects that are successfully carried out in collaboration with the spin-off companies [88].

In case of the procedure system at TTO STU for the different types of TT (patents, creation of technology-based companies, contracts), there are some specific procedures.

Technology transfer is the comprehensive process of transfering scientific knowledge (use), inventions, findings and knowledge caused by research activities in public sector into the economic and social practice focused on their commercial evaluation. Main phases of this proccess are IP protection and its subsequent commercialisation. In the framework of these two phases we can identify following activities that can create steps in the process of technology transfer [57].

- **Origin and protection of intelectual property rights**

Intellectual property (IP) pertains to any original creation of the human intellect such as artistic, literary, technical, or scientific creation. Intellectual property rights (IPR) refers to the legal rights given to the inventor or creator to protect his invention or creation for a certain period of time [69].

Intellectual Property Rights (IPR) have become an essential component in generating and implementing ideas translated into knowledge and technology to promote innovation and economic success [64].

- Origin of intellectual property rights
- Announcement of research results (intellectual property subject, technology)
- Feasibility study and selection of intellectual property rights protection
- Evaluation of technology benefits (intellectual property subject)
- Selection of intellectual property protection strategy
- Implementation of intellectual property rights protection

- **Intelectual property commercialization**

Commercialization in simple words refers to introducing new products or services in the market. Around the world, several rules and regulations are made to ensure that Intellectual Property is commercialized and protected. The main motive of the commercialization of IPR is to encourage people to bring new ideas and creations into the market and make it marketable and profitable [64].

- Selection of commercialization strategy and partner search for its implementation
- Expert consulting services
- Contract research
- Intelectual property commercialization strategies

- **Main processes in TT that require specifics procedures** [88]
- Technology identification
- Intellectual property protection
- Commercial feasibility assessment
- Licensing and agreements
- Prototype development
- Spin-offs or startups

- Commercialization

4.3 Strengths and Weaknesses of TT Units/Offices

In a box, list the main strengths and weaknesses detected in TT units/offices.

Based on our survey[1], we have detected following strengths and weaknesses in TT units/offices in Slovakia.

Strengths	Weaknesses
Employees, experienced workers, capable of creating innovations and solving real practical problems	Low share of commercial forms of transfer of knowledge into practice
Support for the transfer of knowledge, technologies and intellectual property of university into practice.	Personal
Identification, search and coordination of resource planning for the commercialization and development of intellectual property.	Financial
Presentation of research results and intellectual property objects to the public for the purpose of their commercialization and search for suitable partners for commercialization.	Informational
Many years of experience.	Weak connection with the commercial sphere.
Access to patent literature.	Understaffing
Good overview in an academic environment.	Weak marketing
Directive on technology transfer and commercialisation of intellectual property	Large patent portfolio - few licenses
Professional employees	Lack of staff for other activities
Large patent portfolio	Insufficient legislation and uniform procedure and vision of legislators.
Expertise, Continuity, Research activity in-house.	Need a marketer and business developer.
Centralized workplace, overview of all IP at the university. Support from the university management. Active participation in the preparation of internal regulations.	CTT has not own budget. Insufficient personnel capacity. Some workplaces are not interested in the TT area.
Availability towards students and employees. Effective process of applying industrial property rights.	Insufficient capacity of human resources. Financial resources.

[1] September-October 2024

Existence and operation of University Science Park. Support for innovation, startups and commercialization. Involvement of university management (vice-rector for innovation and TT).	Lack of economic resources. Limited marketing capacity. Weak connection with industry in the field of applied research.

Table 9: Strengths and weaknesses in TT units/offices in Slovakia Source: Survey (September-October 2024)

4.4 TT Structure Best Practiques

What best practices have we detected in this case? (1 or several)

- *Name of the HEI/ TT office.*
- *Describe the main characteristics of the structure.*
- *Why is it a "best practice" ? (indicators, innovative aspects)*

Add also if there is an international model on which the local system is based or that is considered a reference (and why).

This activity will be completed in A5. In this case it is a list of BPs and a short description.

We have detected following best practices in Slovak Technology Transfer ecosystem:

(1) Successful technology transfer implemented in the form of a transfer of rights carried out by Technology and Innovation Park of the University of Pavel Jozef Šafárik in Košice and its TTC

(2) Successful commercialization of the product created at the National Forest Centre (NFC) in Zvolen (Forest Research Institute - FRI)

(3) Successful technology transfer implemented at the Slovak University of Technology in Bratislava (STU)

(4) Successful commercialization of the technology created at Slovak University of Technology (STU) in Bratislava and its licensing to an external company

- Name of the HEI/ TT office: Pavol Jozef Šafárik University in Košice, Technology and Innovation Park of the Pavol Jozef Šafárik University in Košice
- Describe the main characteristics of the structure.

Academy-Industry Collaboration between the Pavol Jozef Šafárik University in Košice (Technology and Innovation Park of the Pavol Jozef Šafárik University in Košice), Comenius University in Bratislava, Masaryk University in Brno and the Czech holding group FABA Capital

Successful technological transfer and close cooperation with the commercial and legal department at the Technology and Innovation Park of the Pavol Jozef Šafárik University in Košice.

The cross-border cooperation of a total of three universities and one start-up - brought significant success in the field of technology transfer to the University of Pavel Jozef Šafárik in Košice at the end of 2022.

- Why is it a “best practice”? (indicators, innovative aspects)

Excelent Slovak-Czech cooperation of four organisations - Pavol Jozef Šafárik University in Košice, Comenius University in Bratislava, Masaryk University in Brno and the Czech holding group FABA Capital.

Successful technology transfer and close cooperation with the commercial and legal department. Professionally commercialization process.

The research of two Slovak and one Czech university and the subsequent entry of the holding company FABA Capital bring into practice a new technology that can contribute to the success of assisted reproduction by the IVF method. The task of the start-up, which is part of the FABA Capital group, is now the commercialization of the IVF embryo transfer project.

The new technology, protected by a patent application, identifies new microRNA (miRNA) molecules that can be used in prediction. Simply put, the identified molecules predict the women's current readiness and the quality of the embryo suitable for the artificial insemination process. The importance of the invention is underlined by its nomination for the Technology Transfer Award in Slovakia in 2021, in the Innovation category, and finally, the transformation of the nomination into the victory of the MicroRNA test for the success of the IVF process and diagnostics in its category. The award for technology transfer in Slovakia is awarded by CVTI SR and is a traditional award and motivation for scientists and researchers from scientific research institutions. As part of the commercialization of academic and university projects, a new fabaincube incubator was created.

- Name of the HEI/ TT office: National Forest Centre in Zvolen (NFC), Forest Research Institute

- Describe the main characteristics of the structure.

NFC has cooperated with the Faculty of Forestry at Technical University in Zvolen (preparation of experiments in the laboratory and in the forestry operation) and with Institute of Forest Ecology of the Slovak Academy of Science in Nitra. The process of technology transfer from IP protection to commercialisation of research outputs was realized through Technology Transfer Centre at Slovak Centre for Scientific and Technical Information (CVTI SR).

- Why is it a “best practice”? (indicators, innovative aspects)

The specific Best Practice is about successful commercialization of the product created at the National Forest Centre (NFC) in Zvolen (Forest Research Institute). The new preparation was created as part of applied biopesticides research. It increases the biological protection of the forest against insects, which damage seedlings planted on areas, especially after wind and lycophagus calamities. It uses the beneficial fungus Beauveria bassiana, an insect pathogenic fungus that infects and then kills harmful insects. It is an ecologically acceptable method of protecting seedlings from selected overgrown insect species, which is also financially effective.

In 2022, the team continued research and looked for other ways to use the carrier in the field. The result of commercialization are negotiations with an international company about licensing the subject of intellectual property to the company's portfolio.

NFC was awarded with the prize for the transfer of technologies in Slovakia in the Innovator category for their unique method at Cooperation Innovation Technology Transfer (COINTT) 2021 conference.

- Name of the HEI/ TT office: Slovak University of Technology in Bratislava (STU), Faculty of Chemical and Food Technology (FCHTP)
- Describe the main characteristics of the structure.

Academy-Industry Collaboration between Faculty of Chemical and Food Technology STU in Bratislava (FCHTP), Polymer Institute of the Slovak Academy of Science and the commercial company PANARA.

First Slovak bioplastic NONOILEN, which represents a 100% ecological solution in the field of biodegradable plastics. NONOILEN was created by Slovak scientists as part of PANARA cooperation with the scientific team from the Faculty of Chemical and Food Technology of STU in Bratislava and is protected by Slovak and international patent protection. The material was not only created, but is also commercially used.

- Why is it a “best practice”? (indicators, innovative aspects)

NonOilen is the result of R&D collaboration between scientists from the Slovak Technical University in Bratislava (Faculty of Chemical and Food Technology) and private company PANARA. The goal of both parties is to produce bioplastics with a wide range of practical uses.

Contractually sealed long-term cooperation between FCHPT and the commercial company PANARA is an example of "the best practice". In the field of bioplastics, the faculty used its scientific potential, in which it is supported technically and economically by PANARA, which, on the other hand, as a representative of the business sphere, knows how to create suitable conditions for applied development supported by the faculty and the implementation of research into the industrial production.

Thanks to mutual support, not only was it created, but it is also used commercially. Nonoilen was tested and puted into practice on a pilot basis in several Slovak and foreign companies.

The idea of entering the market with a material that would have the properties of NonOilen was introduced to academia aleread in the 1990s. Later, the knowledge and experience were combined with the risk tolerance of PANARA, which provided the university research with necessary conditions, and also actively took part in a significant portion of the research. Their synergy and enthusiasm for finding the possibilities to create and especially bring to market a truly ecological bioplastic have united into the NonOilen granulate we have today.

- Name of the HEI/ TT office: Slovak University of Technology in Bratislava (STU), Faculty of Mechanical Engineering, Know-how Centre of STU
- Describe the main characteristics of the structure.

Best practice is an example of academy-industry collaboration at Slovak University of Technology in Bratislava. The Know-how Centre of STU as a university-wide workplace of the Slovak Technical University in Bratislava has supported successful commercialization of the technology created at STU and its licensing to an external company.

Name of the product: Granulator of particular material with a flat matrix

The special design of the granulator with a flat matrix has applications when granulating the agglomerate to a precisely defined fractional size with minimal dust formation. Potential customers can be from various areas of industry, mainly chemical, food or the pharmaceutical industry, but also in processing technologies recycled materials/waste.

Describe the main characteristics of the structure.

- Why is it a “best practice”? (indicators, innovative aspects)

The Know-how centre at STU has received a notification from the originator about the creation of an industrial property object under the name “Granulator of particulate material with a flat matrix”, in which the employees of the Faculty of Mechanical Engineering jointly participated. It was followed by the development of a search report processed by the patent information center PATLIB to find out whether there are similar inventions in global databases that could be an obstacle to the filing of a patent application and the granting of a patent. A positive search report and a sufficient level of technology readiness according to the TRL (Technology Readiness Level) scale meant that the STU applied for a solution and started the entire process of protecting the invention.

After the submission of applications, started the cooperation of the Institute of Process Engineering of the STU Faculty of Mechanical Engineering with the Czech company AGRO CS, which expressed interest in the possible commercialization of the technology in the future. On March 16, 2020, the invention was granted a patent. In the second half of 2021, joint meetings of the inventors and representatives of AGRO CS, in Czechia finally resulted in the conclusion of the first ever license agreement for the use of the invention at STU, with the assumption that further license agreements will be concluded in the near future.

- Name of the HEI/ TT office: CU CTT
- Describe the main characteristics of the structure:

CTT UK provides consultations to the originators of inventions/technical solutions, ideally before delivering the notification of the creation of the industrial property. After receiving the notification, they will perform or ensure the performance of a state-of-the-art search and evaluation. Based on the results of the search and evaluation, the CTT will assess the solution and submit to the statutory body the documents for the exercise or non-exercise of the right to the solution. After exercising the right and settling all relationships (if the originators are also students or settling relationships with another institution), the Comenius University proceeds to file a patent or other application for protection, the CU CTT initiates the commercialization process. Potential interested parties in the technology are approached either independently or through the EPS. The CU CTT independently conducts negotiations with interested parties. The Comenius University

uses its contacts in certain areas to gain additional contacts with potential interested parties in the technologies. In the case of commercialization, the CU CTT oversees and coordinates the entire process in cooperation with the Comenius University faculties and originators.

- Why is it a "best practice"? (indicators, innovative aspects):

In 2022, Comenius University in Bratislava, together with UPJŠ in Košice and Masaryk University in Brno, managed to commercialize the invention in the form of a transfer of intellectual property rights. Comenius University was part of the negotiations and actively participated in the process. Masaryk University secured the transfer of the rights through its participation in the first annual Transfera Technology Day event.

5 TT Instruments

List and describe programs used to promote TT from HEIs (for example, research contracts, cooperative research contracts, licences and patents, creation of Spin-off ...).

According to our survey [September-October 2024], to promote TT from HEIs TTC, at TTC STU have used research contracts, cooperative research contracts, licences and patents, creation of spin-off. At UPJŠ Košice have used cooperative research contracts, licences and patents, creation of spin-off. TTC at CVTI have used licences and patents, creation of spin-off. TTC at UNIZA have used cooperative research contracts, licences and patents, creation of spin-off. At TTC of Comenius University have used licences and patents, creation of spin-off. At TTC TUZVO have used research contracts, cooperative research contracts, licences and patents. At TTC of Technical University in Košice have used research contracts, cooperative research contracts, licences and patents, creation of spin-off.

The number of created spin-offs, number of patents and licences in the last 2 years we can see in the following table 10.

	Creation of Spin-Off in the last 2 years	Patents in the last 2 years	Licences in the last 2 years
TTC STU	N/A	60	2
TTC UPJŠ	1	16	0
CTT TUKE	0	131	N/A
TTC CVTI SR	0	35	2
TTC UNIZA	0	35	0
CTT UK	0	7	0
CTT TUZVO	0	0	0

Table 10: The number of created spin-offs, number of patents and licences at the TTCs in Slovakia. Source: Based on survey [September-October 2024],

According to survey [8] provided by CTT CVTI SR, the detected numbers of licenses, number of spin-offs pointed to the low ability of scientific and research institutions to commercialize its IP (these numbers in the Table 11 take into account the longer time period 2011-2022). These data

are influenced by several factors both on the side of scientific and research institutions and on the side of potential demand from the commercial sphere of the Slovak Republic.

	SAV	SPU	STU	TUKE	TUZVO	UK	UNIPO	UNIZA	UPJŠ	UVLF
Number of licences	11	1	2	4	0	1	1	0	0	0
Number of spin-offs	0	1	10	2	0	0	0	1	6	0

Table 11: Licences and spin-offs (2011-2022). Source. CTT CVTI SR (2024)

As for commercialization in the form of establishing a spin-off company, it is the most complex way of commercialization and it requires adequate expertise and experience. With the overall under-dimensioning of technology transfer centers, the process of establishing spin-off companies is beyond the capabilities of Slovak CTTs, with the exception of STU and UPJŠ. Both institutions have established subsidiaries (STU Scientific, SAFTRA) whose activity is to establish innovative companies based on scientific and research institutions IP. Their approach to the issue of spin-offs is therefore more systematic in the long term with noticeable results.

Research contracts

Universities' entrepreneurial activities through research contracts and professional expertise bring additional financial resources and prestige.

In research contract, a contractual relationship is created between the subject of economic practice and the research institution. These entities participate in agreed research, have the possibility to provide each other with consultations, cooperate in the introduction of innovations, etc. The advantage for the research institution resulting from such a relationship is not only additional financial resources, but also the acquisition of the right to use the results of contractual research for the purposes of further research [93].

Licences and patents

Common ways of commercializing intellectual property is by granting licenses (licensing) and transfer of intellectual property rights, while granting license is generally the most common method of commercial evaluation of intellectual property.

An important role in concluding license agreements and transfer agreements is played by yes, in the case of public academic and scientific research institutions, in particular technology transfer centers. CTT is responsible for the content of all licensed contracts and transfer contracts to be submitted to the statutory authority for signature. The main goal of CTT should be to agree and propose a contractual arrangement the most advantageous position for the institution they represent [103].

Creation of spin-off

The creation of a spin-off company within a university in order to support university technology transfer is nothing new in the world. However, it is still a rarity in the environment of Slovakia [7].

The criteria for categorization from the point of view of the university's equity share in the spin-off company, its advantages and disadvantages in relation to the amount of the share, were elaborated by CVTI SR in its document Strategy and establishment of university spin-off companies in the environment of the University of Žilina [16].

5.1 Exchange of Research Staff with Companies

University-business mobility is one of the most interesting mechanisms to promote knowledge transfer.

List and describe what are the main mechanisms to promote this mobility? (for example, University-specific programmes, contracts, Business Chairs, calls for research stays ..).

Which are the legal procedures for the exchange of personnel between companies and public center?

How is the workflow for the authorization system for this mobility, the HEIs have to accept?

What are the main limitations/barriers for this mobility?

Enabling researchers to work across Europe is a key strategy objective for the EU, supporting cross-border knowledge sharing and collaboration and fostering scientific innovation [79].

Based on our survey [September-October 2024], CTTs used to promote exchange of research staff with companies following: in case of CTT STU it does not belong to the activities of CTT. CTT UPJŠ and CTT UNIZA used university-specific programmes and calls for research stays, CTT TUKE and TUZVO used university-specific programmes, contracts and calls for research stays.

An example of these programs is The Marie Sklodowska Curie (MSCA) Personnel Exchanges call.

The Staff Exchanges action offers a unique opportunity to promote the transfer of knowledge and innovation through international research collaborations.

MSCA Staff Exchanges promote innovative international, inter-sectoral and interdisciplinary collaboration in research and innovation through exchanging staff and sharing knowledge and ideas at all stages of the innovation chain. The scheme is part of Horizon Europe, the EU's programme for research and innovation.

The scheme fosters a shared culture of research and innovation that welcomes and rewards creativity and entrepreneurship and helps turn ideas into innovative products, services, or processes.

Staff Exchanges are open to all domains of research and innovation, chosen freely by the applicants, and have a strong focus in interdisciplinary, international and intersectoral cooperation [82].

For example, as part of this call in 2020, 74 new consortia succeeded, including 3 Slovak entities. The company Powertech, was the coordinator of the project with the acronym "SAFEMILK" in the field of natural sciences. Comenius University in Bratislava was also a partner of this project consortium consisting of 10 partners. The company DANUBIA NanoTech, was a partner of the project with the acronym "CompSafeNano" in the field of chemical sciences, consisting of 23 partners [82].

With services in the field of connecting companies with universities, Slovak Investment and Trade Development Agency (SARIO) fulfils the following goals:

- Increasing technology and research transfer from academia to practice
- Stimulation of innovations in Slovak companies
- Improving the practical skills of graduates so that they reflect the demands of the market

Organisations from all socioeconomic sectors in any country can apply to Staff Exchanges. This includes organisations such as

- higher education institutions
- research institutions and infrastructures
- private sector organisations, including industry, businesses, and small and medium-sized enterprises
- public sector organisations, including national, regional, and local governments, agencies, and museums

The flagship of the agenda is the project "Practice for universities, solutions for companies"

As part of the SARIO project, it connects companies with universities in the area of [74]:

- Joint research and development projects
- Assignments of end-of-year works from practice
- Internships

5.2 Internationalization of Knowledge Transfer

Are there specific instruments for the internationalization of TT?

According our survey [September-October 2024], CTTs used following the instruments for internalization of TT: in case of CTT STU it does not belong to the activities of CTT. CTT UPJŠ, CTT TUKE, CTT UNIZA and CTT TUZVO are providing internationalization of TT through international contacts of researchers and through networks of companies and international HEIs.

Among the many EU instruments for the internationalization of SMEs, they have a special one the importance of the EEN network and the Startup Europe initiative. EEN's support services include

a wide range of activities to help EU SMEs in the field of innovation, growth and expansion, both in the EU and beyond its borders. They belong to them providing expertise, contacts and events to support international partnerships and consulting on international markets and innovations. In innovation support are included technology transfer and intellectual property rights [27].

5.3 Tools Used to Publicize the Generated Knowledge

Through which tools (e.g. web pages, catalogues, fairs...) promote their offer.

The main tool used by TTOs to promote their services and activities is through their websites.

Slovak universities use several tools to showcase their generated knowledge:

- Technology Transfer Offices (TTOs): TTOs have services aimed at the commercialization of technologies.
- Websites – university, university research group, TT unit.
- Research offer catalogues.
- Research and Innovation Networks: Platforms like Enterprise Europe Network (EEN), the world's largest support network for small and medium-sized enterprises (SMEs), help also Slovak universities connect with international partners and showcase their technologies.
- Conferences and Trade Shows: Universities participate in global events to present their results of research and innovations.

5.4 Barriers to the Commercialization of Knowledge Generated in HEIs

Main reasons why protected research does not reach the market.

- *Evolution of patent and license commercialization.*
- *Implicated actors and functions:*
  - *Protection.*
  - *Commercialization.*

Main reasons why protected research does not reach the market.

***Specifically**, analyse the difference of opinion (if it exists) between the vision of the field of knowledge (HEis, technology centers...) and the world of the company.*

In the SWOT analysis of Research and Innovation Strategy for Smart Specialization of the Slovak Republic (RIS3) [54], states that the barriers to the use of Intellectual Property Rights protection and insufficient support for their development are among the weaknesses research and innovation environment.

The current situation in the field of technology transfer at universities in Košice, as well as at throughout Slovakia, is primarily characterized by fragmented and duplicative activities

implemented at universities and the associated low level of professionalization of the entire process and the following shortcomings [114]:

- insufficient creation, protection and commercialization of intellectual property,
- lack of an adequate environment for the emergence and development of start-up and expanding companies,
- low scientific and research performance, especially in the area of patents, utility models, designs,
- insufficient use of trademarks or other intellectual property,
- low share of private sector in financing science and research and low innovation performance of small and medium-sized enterprises,
- low level of cooperation between universities and the Slovak Academy of Sciences with the private high-tech sector,
- low or no level of monitoring the success of newly emerging companies.

Main reasons why protected research does not reach the market

Based on our survey, the main barriers to the commercialization of knowledge transfer are:

- Bureaucracy in my organization
- Relevance of the patent in the researcher's curriculum
- Companies do not have a culture favourable to the acquisition of patents or licences
- The research carried out in HEis is basic and non-oriented type, very far from the market
- Lack of public policies and incentives for promotion
- Lack of grants and subsidies
- The research carried out in HEis is basic and non-oriented type, very far from the market
- The productive sector is not capable of absorbing the research offer
- The internationalization of the HEIs technological offer is scarce
- Others:
    - Concerns of businesses about the threat of trade or production secrets;
    - Administrative burden on scientific workers;
    - The ability of the enterprise to define the assignment for research and development.

New European Patent Office analysis also finds the continent remains fractured when it comes to innnovation [80].

Evolution of patent and license commercialization

In Slovakia, around 200 patent applications are filed annually and approximately 100 patents are granted. The number of applications was much higher in previous decades. Between 1995 and 2003, it was no exception that the Industrial Property Office (ÚPV) of the Slovak Republic accepted more than 1,500 applications for the granting of a patent, in 2000 there were even more than 2000.

It must be said that these numbers were increased by foreign applications, the number of Slovak applications never exceeded three hundred. The integration of Slovakia into European structures

in 2004 reduced the share of foreign applications, and it gradually reduced to a few dozen, or even less.

More than a third of patent applications came from universities. Their representation among the granted patents was even higher - almost half of the granted patents were obtained by universities and colleges, especially by the Technical University in Košice, the Slovak Technical University in Bratislava, the University of Žilina and the Slovak Agricultural University in Nitra [100].

5.5 TT Instruments Best Practiques

What best practices have we detected in this case? (1 or several)

- *Name of the HEI / TT office.*
- *Describe the main characteristics of the instrument.*
- *Why is it a "best practice" ? (indicators, innovative aspects)*

Add also if there is an international model on which the local system is based or that is considered a reference (and why).

This activity will be completed in A5. In this case it is a list of BPs and a short description.

In our survey [September-October 2024], the CTTs have identified following TT instruments best practices.

- *CTT UPJŠ*

CTT was established and performs university - wide tasks within the framework of technology transfer and IP protection at UPJŠ. CTT contributes to the development of the university mainly by supporting the commercialization of part of the academic research, it helps the development of cooperation between UPJŠ and production, or commercial sector, popularizes innovative strategies in science, research and education and provides consultations in the field of intellectual property protection. The long-term goal of CTT is the coordination of activities leading to the commercialization of intellectual property and know-how created at UPJŠ in Košice. CTT ensures this goal in close cooperation with creators of intellectual property working at individual faculties and other workplaces of UPJŠ, as well as in cooperation with the activities of the trading company SAFTRA, which is a commercial entity fully owned by the University of Pavel Jozef Šafárik in Košice.

- *CTT TUKE*

One of TUKE's best practices regarding TT tools is active participation in international research projects and the conclusion of cooperation agreements with various foreign universities and research centers. These contracts include the exchange of know-how and the transfer of technologies, whereby TUKE improves its possibilities of commercializing innovations and strengthens its position in the international context. In addition, the Technicom University Science Park serves as a catalyst for establishing cooperation with industrial partners, which contributes to the wider implementation of TT tools.

- *CTT TUZVO*
  - Application of directives relating to industrial property rights
  - Regular seminars for TT support staff
  -

6 Economic Indicators and Funding

- *What financing instruments exist around TT?*
- *Budget allocated by HEIs.*
- *Budget allocated by the public administration.*
- *Researcher's access to funding.*
- *Is there a Policy of Encouragement for Teaching and Research Staff?*

Total annual budget for CTT

Due to the fact that the majority of technology transfer centers of academic institutions do not have the status of an autonomous workplace, they do not have the type of budget that would allow the actual expenses associated with technology transfer to be determined and individual centers to be compared with each other. Some of the reported figures include employee expenses, others do not. A number of personnel expenses are linked to staffing at the faculties and other parts of the science and research institutions, therefore in some cases they do not figure in the budget of the given CTT. In some of the given data, resources intended for the protection of IP are included, while other institutions cover these fees from other sources. In the case of STU, the stated amount includes all expenses, including expenses for patent fees, patent attorneys and office activities as such. Expenditures related to energy consumption, operation of premises, material equipment and the like are often unclear. In any case, the figures presented do not represent the same structure of expenses across all institutions. If it is necessary to record the total budget of local CTT in the following years, it will be necessary to define the items that will be included in the "CTT budget". This will achieve mutual comparability of the obtained data [8].

	SAV	SPU	STU	TUKE	TUZVO	UK	UNIPO	UNIZA	UPJŠ	UVLF
Budget of CTT (EUR)	135 146	33 487	169 200	50 000	8 830	27 000	4 000	N/A	N/A	0

Table 12: Annual budget for the operation of transfer centers in 2022. Source: CTT CVTI SR (2024)

6.1 Distribution of the Budget Among the Involved Agents

Analyse how are the possible incomes derived between the HEI, the TT office and the researcher distributed.
- *Distribution of the budget among the involved agents.*
- *Service fees of the agents.*
- *Distribution of profits from the sale of results (patents, licences).*

The detected numbers of licenses, transfers and the resulting incomes point to the low ability of science and research institutions to commercialize its IP (these numbers take into account the

longer time period 2011-2022). These data are influenced by several factors both on the side of science and research institutions and on the side of potential demand from the commercial sphere of the SR [8].

	SAV	SPU	STU	TUKE	TUZVO	UK	UNIPO	UNIZA	UPJŠ	UVLF
Gross revenue from licenses (EUR)	N/A	0	3000	11 500	0	0	4 207	0	0	0
Gross income from the transfer of rights (EUR)	50 000	0	950	0	0	a*	0	0	a*	0

Table 13: Gross revenue from licenses and Gross income from the transfer of rights. Source: CTT CVTI SR (2024)

*a - the amount is known but subject to trade secret

7 Human Resources and Training

Analyses of the human resources available for TT:
- *Do TT offices have enough resources?*
- *How is the professional profile of human capital?*
- *What training and training do they have?*
- *Do researchers have training on the functioning of TTS?*
- *Do those responsible for companies have training on TT?*

Human resources in Slovakia are the strongest pillar of the innovation index, because the result of their evaluation is closest to the EU level (78.6%) [75].

Based on our survey [September-October 2024], TT offices have not enough human resources and they are understaffed.

According to survey of CTT CVTI SR [8], among the important parameters associated with local technology transfer centers is the number of their workers in full-time equivalents. From the data and information obtained by CTT CVTI SR, it follows that at several research and scientific and research institutions, activities related to technology transfer are carried out by workers only part-time or are carried out by workers from other workplaces than CTT (e.g. legal departments, project departments, etc.). The fact that at some scientific and research institutions (SPU, UK, UNIPO) the number of CTT workers is less than the equivalent of one full-time worker should be considered unsatisfactory. Such a representation of the TT area at scientific and research institutions does not allow for the development of full-fledged CTT competencies. In the case of University of Veterinary Medicine and Pharmacy in Košice (UVLF), it is not possible to speak of a technology transfer center as such. The workplace defined in this way was not established at

UVLF. The basic legal requirements in the area of dealing with IP are carried out by the authorized person

In case of the training of human resources in TT offices, TTC STU and CTT UNIZA are considering it as sufficient. CTT UPJŠ, CTT CVTI SR, CTT UK are considering as insufficient. CTT TUKE and CTT TUZVO neither agree nor disagree. The researchers have training on the functioning of TT in case of CTT STU. CTT UPJŠ, CTT TUKE and CTT CVTI SR neither agree nor disagree. In case of CTT UNIZA, they have not received training, but they are familiar with the Directive, which regulates the activity of CTT as well as related processes. In case of CTT UK, they hold seminars for university employees, provide consultations, but these are not mandatory and the information will therefore not reach all employees. The responsible for companies have training on the functioning of TT, CTT UPJŠ does not agree, CTT CVTI SR neither agree nor disagree, others don ´t know.

8 Relationships Between the Agents of the Ecosystem

Describe in which ways (e.g., forums, meetings, open innovation programs.) the different agents of the ecosystem (TT offices, HEIs and companies) are related.

- *Evolution of private sector implication.*
- *Collaboration and knowledge transfer between HEIs.*
- *Specialization of HEIs in knowledge areas.*
- *Involvement of external entities (Hubs, clusters, ecosystems).*
- *Collaboration and knowledge transfer with international agents.*

In Slovakia, individual agents of the innovation ecosystem such as Technology Transfer Offices (TTOs), Higher Education Institutions (HEIs), and companies are connected through various platforms, forums, meetings, and programs that promote collaboration, knowledge exchange, and technology transfer. Below are some of the main ways these agents interact:

- **Industry-Academia Forums and Conferences**

Innovation forums, technology transfer conferences, and research-industry meetings bring together universities, TTOs, and companies to foster collaboration.

Examples:

- COINTT conference, as the biggest event in Slovakia devoted to technology transfer, intellectual property rights, innovations, and business support. Conference was connected academia with industry.[2]
- CVTI SR and CTT SAV are organising conferences “Technology transfer in Slovakia and abroad”.

These events provide networking opportunities and help identify potential collaborations or research commercialization avenues.

[2] https://cointt.sk/en/home-english/

- **Open Innovation Programmes**

Open innovation programs are platforms where universities and companies collaborate to solve real-world challenges using academic research and technology. Companies openly share their innovation needs, and researchers or startups propose solutions.

Examples:

- Hackathons or innovation challenges: The Ministry of Investments, Regional Development and Informatization (MIRRI) has announced a call for grants with simplified administration ("Fast grants") - Hackathons. Hackatons will be organized with the participation of startups, IT companies, research institutions, universities, students and other experts. The role of hackathons is to bring innovative solutions to beneficiaries in the areas of streamlining processes, improving the quality of digital services to citizens, and addressing current societal challenges.
- Corporate innovation programs: Most coommon innovation programms are Entrepreneurship programs, Innovation labs, Internal accelerators. For example Automotive innovation Lab STU as a joint laboratory of multiple faculties at Slovak University of Technology located in Bratislava. Innovate Slovakia is building a community by co-organizing local events and connecting key stakeholders in the Innovation ecosystem.

- **Public-Private Collaboration Projects**

Universities, companies, and TTOs also collaborate through public-private partnership (PPP) programs. STU also wants to more intensively collaborate with cities, regions and partners on innovations, and offer its research and proven project output and know-how to improve the environmental and sustainable environment of this country [67].

Examples:

- Horizon Europe and other EU programs: Promote university-industry partnerships for large-scale research projects.
- Strategic Collaboration Agreements: Some universities and companies enter long-term agreements for joint research and development in fields like biotech, engineering, or artificial intelligence. STU and the companies of IBM Slovensko, and IBM International Services Centre (IBM) agreed on mutually beneficial forms of cooperation. It concerns the support of scientific research mainly through bilateral and multilateral projects. The cooperation will also concern the common STU and EIT Manufacturing RIS Hub Slovakia's activities, in particular linking the innovative ecosystem in the field of industrial production, promoting EIT Manufacturing and EIT Manufacturing RIS Hub Slovakia, and also expanding the network of organizations cooperating with EIT Manufacturing in Slovakia [66].

- **Innovation and Technology Transfer Consortia**

Consortia bring together multiple universities, research centers, and companies to address technological challenges. These consortia pool resources and expertise from different sectors to advance research and bring innovations to market faster. An example is the Ukrainian-Slovak International Center for Innovation and Technology Transfer in the form of an International Innovation Consortium [117].

- **Technology Transfer Meetings:** Meeting of the members of the expert commissions of the National Center of Technology Transfer of the Slovak Republic (NCTT SR).

TTOs organize or participate in technology transfer days or brokerage events, where universities showcase patent portfolios, research outcomes, or innovation projects to industry representatives. These meetings are designed to create licensing opportunities or research partnerships between academia and companies.

- **Science and Technology Parks**

Science and technology parks play a key role in creating physical spaces for interaction between universities, companies, and research institutes. Parks like provide incubators, accelerators, and office spaces where startups and university spin-offs can grow alongside larger firms and research centers. This proximity promotes informal collaborations, networking, and joint R&D projects.

Examples:

- Technicom University Science Park in Košice serves as a catalyst for establishing cooperation with industrial partners, which contributes to the wider implementation of TT tools.
- The STU University Science Park (USP) as a major research and innovation hub disposing of the most modern infrastructure for scientific research in Slovakia. As an integral part of the University, USP provides a strong foundation for science and research and enables the integration of a large number of the STU labs and partners in the European Research Area (particularly Comenius University and Slovak Academy of Sciences).

- **Innovation Clusters:**

Innovation clusters are another way these agents collaborate. Clusters such as Košice IT Valley (IT cluster).

Example:

- Košice IT Valley – creates conditions for knowledge and technology transfer between academic sector and IT industry. The vision of Košice IT Valley cluster initiative is to create a regional partnership of IT companies, education institutions and regional authorities that will contribute to the extension and quality increase of educational programs, the creation of a broad portfolio of job opportunities for qualified work force and the elaboration of a common strategy [26].

- **University Spin-offs and Start-up Incubation Programs:**

Universities and TTOs often assist researchers in forming spin-offs to commercialize academic research. These companies, in turn, often collaborate with industry partners or attract investment. Many universities provide incubation programs, such as the Slovak University of Technology, which helps entrepreneurs develop business ideas.

Example:

- Slovak University Startup Cup – the aim is to recognize and reward the young generation of entrepreneurs who have innovative ideas. At the same time, it is intended to help them transform their innovative solutions into real businesses [83].

- **Training Programs and Knowledge Exchange**

Companies and universities collaborate on training programs, workshops, or executive education courses, aimed at enhancing industry skills or applying academic research in real-world contexts. This promotes direct interaction between academic experts and business professionals.

Example:

- Regional Innovation Center of the Košice Region (ICCK) – main responsibility is to implement the regional innovation strategy and stimulate the further development of the innovation ecosystem. ICCK implements innovative education at high schools and universities, and create programs to support startups and SMEs.

Conclusion:

The successful application of university technology transfer in the country must also have its background in individual regions. An excellent example of cooperation between universities and entrepreneurs, which we already see in Slovakia, are the regional innovation centers that were established in the Banská Bystrica and Košice regions.

9 Public Administration

Analyse how public administration (national/regional/local) impacts on TT:

- *Policies and incentives for promotion initiated.*
- *Allocation of grants and subsidies.*
  - *List the most notable aid at the national/regional level.*
- *Level of involvement and approach to HEI activity.*
- *Specialized public personnel integrated into technology transfer.*

Slovakia is one of the most dependent countries on European funds in the EU-27. ESIF and the Framework Programme for RTD (Horizon) form the core, while EEA and Norway Grants also

provide opportunities for collaborative bottom-up innovation projects, also involving SMEs. Competitive international funding (Horizon) is centred on the Bratislava and Košice regions, but international competitive funding is lacking in most other regions. As such, there is a heavy reliance on non-competitive ESIF investments. There is a positive trend of increasing private sector investment in Slovakia. With regards to national funding, the largest source is awarded through block funding to universities and to a lesser extent to public research institutes. However, block funding is currently not linked to excellence-related criteria and spread across a large number of institutions, making it somewhat ineffective [53].

In the Slovakia in case of R&D&I, there is also horizontal hierarchy of public entities, where some are responsible for designing action plans and others for implementing them.

The main agents responsible for the design and distribution of funding and policies are as follows:

- **The Technology Transfer Centre at CVTI SR** (CTT CVTI SR): is involved in the following tasks at the national level:
- builds and operates the National System for Supporting Technology Transfer, including support for establishing and development of local technology transfer centres
- provides information and specialist support to R&D organisations in the process of technology transfer from intellectual property protection to commercialisation of research outputs
- bears responsibility for administration and operation of the National Portal for Technology Transfer
- **Research and innovation authority** (VAIAI): is a unit of the Government Office responsible for the creation and coordination of research and innovation policies with the aim of transforming Slovakia into an ambitious and innovative country.

- **Ministries**:
- ***Ministry of Education, Research, Development and Youth of the Slovak Republic*** is the central body of the state administration of the Slovak Republic for elementary, secondary and higher education, educational facilities, lifelong learning and for the state's support for research, development and youth.
- ***Ministry of Economy of the Slovak Republic*** aims to improve the business environment by simplifying and streamlining business processes, but also to create an environment that supports a significant increase in the share of research and development in business entities.

RTDI policy is centralised and led by the Ministries of Education Research, Development and Youth and of Ministry of Economy. Although there are effective forums for coordination of RTDI at ministry level, the general view is that policy coordination overall is problematic. This is due to the large number of decision-making layers, resulting in a lack of transparency, as well as issues with human resources. For the private sector this means navigating a the large number of different agencies, frequent legislative changes and increased administrative costs for start-ups and SMEs that are crucial to ensuring successful knowledge transfer [52].

- Protection of intellectual property

One of the key tools for research and innovation is an effective intellectual property protection system. Therefore, it is important that strategic documents also reflect this need.

Through RIS3, the government proposed a measure that aimed to: "contribute to the protection and use of intellectual property and technological transfer as well as to increase awareness of their protection and commercialization, including changing the legislation with regard to practical needs and previous experience." (RIS3, 2013). Institutions across sectors, from ministries to universities, were supposed to cooperate on it schools, and one of the measurable indicators of its fulfilment should have been the number of patents and licenses created. Certain steps in this area were taken as part of the implementation of the National Infrastructure project for the support of technology transfer in Slovakia - NITT SK, when the national transfer portal was created of technologies under the management of CVTI SR. The portal provides both research and expert support services to implement the individual steps of the technology transfer process.

- Popularization of research results

In the framework of state policies dealing with technology transfer, technology transfer is understood as (mostly) financial exploitation of the property of an academic institution in the form of intellectual property (IP) that the institution itself has created. At the same time, it is true that there are procedures known for decades, applied in countries all over the world, for the implementation of TT at academic institutions [31].

- Allocation of grants and subsidies.

CVTI SR created and operates a nationwide infrastructure to support the transfer knowledge and technologies into practice through two national projects (National infrastructure for the support of technology transfer in Slovakia - NITT SK) – one implemented in the 2007-2013 program period and the second implemented in the current one program period 2014-2020 [123].

- List the most notable aid at the national/regional level.
- Voucher for patents from the Fund for SMEs grant program. Due to the high demand and limited availability of funds, the drawing of grants from vouchers for patents was closed as of June 10, 2024.
- Patent Fund was also established, which NCTT SR participants can use - under specified conditions - to ensure the industrial protection of intellectual property originating from public scientific research institutions of Slovakia.

10 Conclusions

- *Main characteristics observed.*
- *Analysis of weaknesses / strengths of the national system.*
- *Recommendations to be adopted by the national TT system.*

Make special emphasis on whether there are differences between the vision of the field of knowledge (HEIs, technological centers...) and the business sectors.

Slovakia has pockets of highly innovative activities in ICT and engineering, biomedicine, bioeconomy, for example, but it suffers from underfunding, fragmentation of actors and activities and the absence of sufficient private sector investment [53].

Based on the results of the European Innovation Scoreboard 2024, Slovakia slightly improved its innovation performance, but most EU countries are progressing faster. The stagnation of Slovakia in European Innovation Scoreboard (24th place in 2024) reflects the situation before the adoption of the National Research, Development and Innovation Strategy 2030 [119].

According to Slovak biochemist Pavol Čekan, technology transfer is very important, but many in Slovakia do not even know what it is. We are certainly lagging behind the world in this [42].

Despite the recent status quo in Slovak TT ecosystem, some of the Slovak self-government regions has started to change their behaviour regarded their innovation ecosystem (e.g. Košice region).

The Košice region, known for its high-quality universities and technological background, is increasingly becoming the epicentre of innovation [34].

- *Main characteristics observed*

In addition to the aforementioned lack of a "culture of IP awareness", the amount of administrative and maintenance fees and the financial intensity of patent attorneys' services have a significant impact on the poor performance of Slovak companies and academia in the area of IPR protection and enforceability. There is a lack of sufficient financial and educational support as well as expertise in this area in Slovakia. However, it cannot be said that no support is implemented – there are, for example, PATLIB Patent Information Centres initiatives in the CVTI SR related to IP searches, training and consulting services, several mentoring/networking platforms (e.g. CIVITTA, BIOHUB SK) also focused on education and support in generating a quality portfolio in the area of IPRs. Within the EU, however, the level of systematic support is at a higher level and it is therefore essential to significantly strengthen awareness and information about such European platforms among Slovak business as well as other research entities focused on the commercialisation of applied research [118].

Slovakia is geographically small country, with low investments in R&D and education, these circumstances has direct influence on technology transfer ecosystem as well. On the government level, the negative influence has regularly change of governments and ministers of education, and science, research and education is still not the priority in comparison to other EU countries.

According to the conclusions of survey provided by CTT CVTI SR [8], the process of protection and commercialization of IP in Slovakia has progressed over the past 12 years both at the local and national level (targeted programs, projects) and the conditions for its further development have been created.

The current situation in the field of technology transfer at universities in Košice, as well as at throughout Slovakia, is primarily characterized by fragmented and duplicative activities implemented at universities and the associated low level of professionalization of the entire process.

The biggest obstacle of the research and innovation system is its fragmentation and weak cooperation and coordination of support between responsible institutions

Our main finding, which is relevant for the area of TT in Slovakia, concerns the origin functional TT infrastructure in the academic environment, which is made up of local level in the environment of individual academic institutions and national level created within CVTI SR as the bearer of NP.

- *Analysis of weaknesses / strengths of the national system.*

Weaknesses of the national system

- absence of national strategy for TT,
- low level of research funding, an unattractive research environment or a low share of SMEs dedicated to innovation,
- weak innovative performance,
- the current legislative framework provides not sufficient support for TT,
- a large number of patents are created (e.g. at universities), but in practice there is not much interest in them,
- fragmented institutions,
- undersized staff at technology transfer centres,
- the topic of organized protection and commercialization of IP remains a marginal topic in the Slovak research environment.

Strengths of the national system

- the process of commercialization of IP has progressed over the past 12 years both at the local and national level (targeted programs, projects) and the conditions for its further development have been created,
- all relevant research and educational institutions (at least the largest universities and the Slovak Academy of Sciences) have workplaces dedicated to the field of technology transfer (CTT) and are thus available to the scientific community and the external environment with the aim of commercial evaluation of research and development outputs [8].

- *Recommendations to be adopted by the national TT system.*

- Ensure the continuity in funding of the basic components of the national infrastructure for TT.
- Reduce fragmentation of institutions.
- Create independent workplaces with full decision-making competences, led and managed by experts in the field of protection and commercialization of IP in the required number.
- Provide evidence of contractual research according to the categories of joint research, contract research and consultation both for the purposes of technology transfer and for annual reports.
- Ensure that collaborations based on contractual research pass through the technology transfer centers of the respective R&D institution.
- Propose a system and conditions of a certain standard for scientific and research institutions in the field of knowledge transfer at the national level, which the R&D institution would be obliged to gradually implement [8].

- Expand the content focus of the national TT system also to actively stimulate the use of public research infrastructure as a new tool for intensifying cross-sectoral R&D cooperation with the aim of increasing the intensity of the creation of new intellectual property.
- On the government level in cooperation with other relevant institutions focused on the adoption of others measures to support TT activities in the R&D sector.

11 Bibliographic References

List the main bibliographic references (also webs) used, specifying the author, the name of the publication and the year of publication.

For instance ""Testar Xavier "La transferencia de tecnología y conocimiento universidad-empresa en España: estado actual, retos y oportunidades" 17/2012"".

1. Balog, M. (2013). Inovatívne Slovensko. SIEA. URL: https://www.siea.sk/wp-content/uploads/inovacie/publikacie/publikacia_Inovativne_Slovensko_vychodiska_a_vyzvy_SIEA.pdf
2. Balog, M. (2018). Regional Aspects of the Slovak Science Parks and Research centers. URL: https://www.prog.sav.sk/wp-content/uploads/BALOG_REGIONAL-ASPECT-OF-THE-SLOVAK-SCIENCE-PARKS-AND-RESEARCH-CENTRES.pdf
3. Balog, M. (2019). Vedecké parky a výskumné centrá na Slovensku. Prognostický ústav SAV. URL: https://prog.sav.sk/wp-content/uploads/Miroslav-Balog-Vedecke-parky-a-vyskumne-centra-na-Slovensku.pdf
4. Báliková, K., Marcineková, L., Šálka, J. (2022). Znluvný výskum v prostredí Technickej univerzity vo Zvolene. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/zmluvny-vyskum-v-prostredi-technickej-univerzity-vo-zvolene/
5. Báliková, K., Šálka, J. (2022). SWOT analýza Technickej uiverzity vo Zvolene- pre inovácie a transfer poznatkov do praxe. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/swot-analyza-technickej-univerzity-vo-zvolene-pre-inovacie-a-transfer-poznatkov-do-praxe/

6. Behúlová, M., Rybanská, L., Molnárová N. (2023). Úspechy komercializácie na STU v Bratislave. URL: https://ttb.sk/clanky/uspechy-komercializacie-na-stu-v-bratislave/
7. Bezáková,J., Karlík, M. (2023). Napredovanie transferu technológií v znamení dvoch spoločností. URL: https://ttb.sk/clanky/napredovanie-transferu-technologii-v-znameni-dvoch-spolocnosti/
8. CTT CVTI SR (2024). Prieskum aktuálneho stavu vybavenosti a výkonnosti vedeckovýskumných inštitúcií v oblasti transferu technológií na Slovensku.
9. CTT CVTI SR (2024). SPRÁVA 2023. URL: https://nptt.cvtisr.sk/buxus/docs//ESP_spravy/2023_EPS_report.pdf
10. COINTT (2023). TECHNOLOGY TRANSFER: Successful transfer of industrial property rights in the current environment of academic institutions of the Slovak Republic. URL: https://cointt.sk/en/session/technology-transfer-successful-transfer-of-industrial-property-rights-in-the-current-environment-of-academic-institutions-of-the-slovak-republic/
11. COINTT (2022). Zvýšenie povedomia o vzniku spin-off spoločností v akademickom prostredí. URL: https://cointt.sk/session/zvysenie-povedomia-o-vzniku-spin-off-spolocnosti-v-akademickom-prostredi/
12. COINTT (2021). Legislatívne prekážky pri realizácii transferu technológií na Slovensku. URL: https://cointt.sk/session/legislativne-prekazky-pri-realizacii-transferu-technologii-na-slovensku/
13. Comenius University Science Park Incubator (2024). URL: https://cusp.uniba.sk/en/departments/incubator/about/
14. Comenius university Bratislava (2024). CTT UK. Survey - Technology Transfer Ecosystem WP2:A4, 14.10.2024
15. Comenius University Bratislava (2022). Innovation Centre of Industrial Property. URL: https://www.flaw.uniba.sk/en/news-detail/back_to_page/pravnicka-fakulta-uk/article/inovacne-centrum-priemyselneho-vlastnictva/
16. Čorejová, A. (2021). Zakladanie spin.off firiem v univerzitnom prostredí. URL: https://ttb.sk/clanky/zakladanie-spin-off-firiem-v-univerzitnom-prostredi/
17. CVTI SR (2021). TRANSFER TECHNOLÓGIÍ Bulletin, Nr. 1/2021. ISSN 1339-2654
18. CVTI SR (2020). TRANSFER TECHNOLÓGIÍ Bulletin. Výskum a trh musia spolupracovať. URL: https://ttb.sk/clanky/vyskum-a-trh-musia-spolupracovat/
19. CVTI SR (2019). Prečo je pre krajinu dôležité mať funkčný transfer technológií? URL: https://vedanadosah.cvtisr.sk/ine/preco-je-pre-krajinu-dolezite-mat-funkcny-transfer-technologii/
20. CVTI SR (2014). TRANSFER TECHNOLÓGIÍ Bulletin, Nr. 2/2014, URL: https://nitt.cvtisr.sk/buxus/docs//Aktivita_3n.1/TTB/TTb_final_2014_02.pdf
21. CVTI SR (2014). Duševné vlastníctvo a transfer technológií. URL: https://nptt.cvtisr.sk/buxus/docs///Dusevne_vlastnictvo_a_transfer_technologii_6.pdf
22. EC (2024a). Economic forecast for Slovakia. URL: https://economy-finance.ec.europa.eu/economic-surveillance-eu-economies/slovakia/economic-forecast-slovakia_en
23. EC (2024b). European innovation scoreboard. URL: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/european-innovation-scoreboard_en

24. EC (2023a). Regional innovation scoreboard. URL: https://research-and-innovation.ec.europa.eu/statistics/performance-indicators/regional-innovation-scoreboard_en
25. EC (2023b). Competence Centre on Technology Transfer. URL: https://knowledge4policy.ec.europa.eu/technology-transfer/what-technology-transfer_en
26. EC (2017). European Cluster Observatory REPORT. Priority Sector Report: Digital Industries.
27. ECA (2022). Nástroje internacionalizácie MSP. URL: https://www.eca.europa.eu/lists/ecadocuments/sr22_07/sr_internationalisation-smes_sk.pdf
28. Farenzenová, E. (2023). Národná stratégia výskumu, vývoja a inovácií zasiahne aj transfer technológií. URL: https://patlib.cvtisr.sk/buxus/generate_page.php?page_id=2807
29. Giuri, P., Munari, F., Scandura, A., Toschi, L. (2019). The strategic rientation of universities in knowledge transfer activities. In: Technological Forecasting & Social Change 138. URL: https://cris.unibo.it/retrieve/e1dcb338-a2cb-7715-e053-1705fe0a6cc9/strategic%20orientation.pdf
30. Habodászová, Ľ., Husseinová, E. (2024). Krajské inovačné skóre Slovenska. VAIA. URL: https://vaia.gov.sk/wp-content/uploads/2024/08/KISS_Krajske-inovacne-skore-Slovenska.pdf
31. Havlíčková, K., Straka, D. (2020). Analýza výskumných a inovačných politík v SR 2004-2020. SOVVA. URL: https://www.sovva.sk/wp-content/uploads/2020/11/V-teorii-a-v-praxi-Analyza-Val-politik-SR.pdf
32. HN (2023). Trnava bude mať vedecký park za desiatky miliónov. URL: https://hnonline.sk/slovensko/521844-trnava-bude-mat-vedecky-park-za-desiatky-milionov
33. Huňady, J., Pisár, P. (2017). University spin-off companies in Europe: the factors and policies influencing their formation. URL: https://aak.slu.cz/pdfs/aak/2017/01/03.pdf
34. ICKK (2024). TOP technologické startupy z Košického kraja, ktoré sa oplatí sledovať. URL: https://ickk.sk/2024/11/15/top-3-technologicke-startupy-z-kosickeho-kraja-ktore-sa-oplati-sledovat/
35. Industrial Property Office of the Slovak Republic (2024). Responsibilities and competence. URL: https://www.indprop.gov.sk/en/office/about-the-office/responsibilities-and-competence
36. Innovate Slovakia (2023). Slovakia accepted new Strategy for research, development and innovation 2030. URL: https://innovateslovakia.sk/en/blog/slovakia-accepted-new-strategy-for-research-development-and-innovation-2030/
37. Jakab, F. (2021): Univerzitné vedecké parky ako kľúčový prvok ekosystému transferu technológií a inovácií na Slovensku. URL: https://patlib.cvtisr.sk/buxus/generate_page.php?page_id=2708
38. Jakab, F. (2020): Science parks as ecosystems for efficient technology transfer and innovation, 2/2020. URL: https://amcham.sk/publications/issues/2020-2-innovations-in-the-digital-age/article/273293/science-parks-as-ecosystems-for-efficient-technology-transfer-and-innovation
39. Karlík, M. (2023a). Podpora transferu technológií je podpora našej budúcnosti. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/podpora-transferu-technologii-je-podpora-nasej-buducnosti/

40. Karlík, M. (2023b). Vedecké parky a ich úloha v podpore vedy a praxe. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/vedecke-parky-a-ich-uloha-v-podpore-vedy-a-praxe/
41. Karlík, M. (2022). Lesnícka inovácia proti škodcom slávi úspech. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/lesnicka-inovacia-proti-skodcom-slavi-uspech/
42. Karlík, M. (2020). Výskum a trh musia spolupracovať. URL: https://ttb.sk/clanky/vyskum-a-trh-musia-spolupracovat/
43. Klinka, T. (2022). Legislatívne prekážky komercializácie duševného vlastníctva na pôde Slovenskej akadémie vied po jej transformácii v roku 2022. URL: https://ttb.sk/clanky/legislativne-prekazky-komercializacie-dusevneho-vlastnictva-na-pode-slovenskej-akademie-vied-po-jej-transformacii-v-roku-2022/
44. Klinka, T. (2021). Vnútorné predpisy v oblasti transferu technológií. In: TRANSFER TECHNOLÓGIÍ Bulletin. URL: https://ttb.sk/clanky/vnutorne-predpisy-v-oblasti-transferu-technologii-pravny-pohlad/
45. Klinka, T. (2020). Legislatívne prekážky efektívneho transferu technológií na Slovensku. In: TRANSFER TECHNOLÓGIÍ Bulletın. URL: https://ttb.sk/clanky/legislativne-prekazky-efektivneho-transferu-technologii-na-slovensku/
46. Košice Self-governing Region. Podpora Startup Centra TUKE Košickým samosprávnym krajom na roky 2017 – 2019
47. Kubiš, M. (2022). Centrum vedecko-technických inormácií a štátne politiky v oblasti transferu technológií. In: TRANSFER TECHNOLÓGIÍ Bulletin.URL: https://ttb.sk/clanky/centrum-vedecko-technickych-informacii-sr-a-statne-politiky-v-oblasti-transferu-technologii/
48. Kundríková, J., Závodská, A., Soviar, J. (2016). Technology Transfer – Case of Slovak Academic Environment. URL: https://eudl.eu/pdf/10.1007/978-3-319-33681-7_58
49. Leon-Roa, C., Zuniga-Callazos, A., et al. (2024). Valorization of research results for knowledge and technology transfer in public higher education institutions. In Joulrnal of Open Innovation: Technology, Market and Complexity. Vol. 10, Issue 1, March 2024. URL: https://www.sciencedirect.com/science/article/pii/S2199853124000398
50. Majchrák, N., Hodoňová, S. (2014). Stratégia zakladania univerzitných spin-off v prostredí Žilinskej univerzity v Žiline. URL: https://nitt.cvtisr.sk/buxus/docs//Vystupy_etapa_3/UNIZA_-_analyza_zakladania_spin-off_firiem.pdf
51. Ministerstvo hospodárstva SR (2022). Technologické centrá. URL: https://www.economy.gov.sk/podnikatelske-prostredie/technologicke-centra
52. Ministerstvo školstva, výskumu, vývoja a mládeže SR (2023). Transfer technológií opäť téma číslo jeden. Program najväčšieho odborného podujatia k problematike sa už chystá. URL: https://www.minedu.sk/transfer-technologii-opat-tema-cislo-jeden-program-najvacsieho-odborneho-podujatia-k-problematike-sa-uz-chysta/
53. MIRRI (2020). Supporting the transformation of the Slovak economy by increasing its innovation performance. URL: https://vaia.gov.sk/wp-content/uploads/2024/03/RTDI-in-Slovakia-AS-IS-report.pdf
54. MIRRI (2021). Research and innovaition strategy for smart specialization of the Slovak Republic 2021-2027. URL: https://mirri.gov.sk/wp-content/uploads/2018/10/Research-and-innovation-strategy-for-smart-specialisation-of-the-Slovak-Republic-2021-2027.pdf

55. Noskovič, J. (2017). Využitie výsledkov výskumu a vývoja a transfer technológi. URL: https://www.ceved.sk/images/CEVED%20seminare/Seminar%20CVTI/Transfer%20technologii.pdf
56. NPTT (2024a). Legislatíva. URL: https://nptt.cvtisr.sk/sk/transfer-technologii/legislativa.html?page_id=309
57. NPTT (2024b). Technology transfer. URL: https://nptt.cvtisr.sk/national-portal-for-technology-transfer/technology-transfer.html?page_id=750
58. NPTT (2024c). Národná stratégia výskumu, vývoja a inovácií zasiahne aj transfer technológií. URL: https://nptt.cvtisr.sk/buxus/generate_page.php?page_id=5293
59. NPTT (2024d). Univerzitné vedecké parky ako kľúčový prvok ekosystému transferu technológií a inovácií na Slovensku. URL: https://nptt.cvtisr.sk/buxus/generate_page.php?page_id=4999
60. NPTT (2024e). Národné centrum transferu technológií SR - NCTT SR. URL: https://nptt.cvtisr.sk/nctt.html?page_id=4444
61. NPTT (2024f). National technology transfer support system. URL: https://nptt.cvtisr.sk/national-portal-for-technology-transfer/national-technology-transfer-support-system.html?page_id=1656
62. OECD (2021). SME and Entrepreneurship Policy in the Slovak Republic. URL: https://www.oecd.org/en/publications/sme-and-entrepreneurship-policy-in-the-slovak-republic_9097a251-en.html
63. OECD (2010). Creating and Applying Knowledge. URL: https://www.oecd-ilibrary.org/
64. Prarapati, A., Khan, A. (2022). Commercializing intelectual property rigihts & significance of competition laws. URL: https://nluassam.ac.in/docs/Journals/IPR/vol1-issue-1/9.pdf
65. RRZ (2023). 2023 General Government Budget Results. URL: https://www.rrz.sk/en/hospodarenie-rozpoctu-verejnej-spravy-v-roku-2023/
66. Rybanský, J. (2022a). STU and IBM intensify their collaboration. URL: https://www.stuba.sk/english/news/news/stu-and-ibm-intensify-their-collaboration.html?page_id=15827
67. Rybanský, J. (2022b). We have the potential to be leaders in the development of energy communities. URL: https://www.stuba.sk/english/news/news/we-have-the-potential-to-be-leaders-in-the-development-of-energy-communities.html?page_id=14964
68. Saftra Photonics (2024). URL: https://www.saftra-photonics.org/
69. Saha, Ch.N., Bhattacharya, S. (2011). Intellectual property rights: An overview and implications in pharmaceutical industry. URL: https://pmc.ncbi.nlm.nih.gov/articles/PMC3217699/
70. SAIA (2024). Higher Education Institutions. URL: https://www.studyinslovakia.saia.sk/en/main/study-in-slovakia/higher-education-in-slovakia/higher-education-institutions
71. Sališ, S., Noskovič, J. (2022). Rozhodovanie predchádzajúce založeniu univerzitnej spin-off alebo spin-out spoločnosti. URL: https://ttb.sk/clanky/rozhodovanie-predchadzajuce-zalozeniu-univerzitnej-spin-off-alebo-spin-out-spolocnosti/
72. SARIO (2024a). R&D & Innovation Sector in SLOVAKIA. URL: https://www.sario.sk/sites/default/files/sario-research-and-development-2024-02-21.pdf
73. SARIO (2024b). Súkromné RD centrá - mapa.
74. SARIO (2023). Prepájanie firiem s univerzitami. URL: https://www.sario.sk/sk/prepajanie-firiem-s-univerzitami

75. SAV (2024a). Kapacity domáceho výskumu sa zvyšujú najmä vo firmách. URL: https://www.sav.sk/?lang=sk&doc=services-news&source_no=20&news_no=12312
76. SAV (2024b). KTT SAV o transfere technológií na pôde SAV. URL: https://ktt.sav.sk/ktt-sav-o-transfere-technologii-na-pode-sav/
77. SAV (2023). Biele miesta v inováciách a v transfere technológií témou konferencie COINTT. URL: https://www.sav.sk/?lang=sk&doc=services-news&source_no=20&news_no=11492
78. SAV (2015). University Science Park for Biomedicine. URL: https://www.sav.sk/index.php?lang=en&doc=services-news&news_no=6148
79. Science|Business (2024a). After two decades, has Euraxess helped to close the east-west knowledge gap? URL: https://sciencebusiness.net/news/research-and-innovation-gap/after-two-decades-has-euraxess-helped-close-east-west-knowledge
80. Science|Business (2024b). European universities are taking control of academic patenting. URL: https://sciencebusiness.net/news/r-d-funding/european-universities-are-taking-control-academic-patenting
81. SLORD (2024). 21 Slovak startups to watch in 2024. URL: https://slord.sk/en/aktualita/21-slovak-startups-to-watch-in-2024/
82. SLORD (2020). Výsledky výzvy MSCA-rise 80-milionov eur na podporu mobility výskumníkov a inovátorov. URL: https://slord.sk/aktualita/vysledky-vyzvy-msca-rise-80-milionov-eur-na-podporu-mobility-vyskumnikov-a-inovatorov/
83. Slovak Academy of Sciences (2024). Technology Transfer Office. URL: https://ktt.sav.sk/en/about-us/technology-transfer-office/
84. SLOVAK UNIVERSITY STARTUP CUP 2024. URL: http://www.studentstartup.sk/
85. SOVVA (2021). Analýza výskumných a inovačných politík. URL:https://www.sovva.sk/wp-content/uploads/2020/11/V-teorii-a-v-praxi-Analyza-Val-politik-SR.pdf
86. SPU (2024). Výskumné centrum AgroBioTech. Transfer Center. URL: https://www.agrobiotech.sk/en/transfer-centre/
87. SRK (2023). Slovenské univerzity v QS World University Rankings 2023. URL: https://www.srk.sk/sk/aktuality/579-slovenske-univerzity-v-qs-world-university-rankings-2023
88. Stebelis, D. (2024). Defining phases of the Technology Transfer process. URL: https://www.linkedin.com/pulse/defining-phases-technology-transfer-process-davids-stebelis-h4e3f/
89. STU (2024a). Výročná správa o činnosti STU za rok 2023. URL: https://www.stuba.sk/buxus/docs/stu/informacie_o/stu/organy_akademicke_samospravne/zasadnutia_vedenie/08_Vyrocna_sprava_o_cinnosti_STU_2023-2024-03-27.pdf
90. STU (2024b). Innovations. URL: https://www.stuba.sk/english/science-and-research/innovations.html?page_id=7438
91. STU (2024c). Survey - Technology Transfer Ecosystem WP2:A4, 13.9.2024
92. STU (2024d). CTT STU. Poskytované služby. URL: https://www.stuba.sk/cttstu/poskytovane-sluzby.html?page_id=16800
93. STU (2016). University of Parks. URL: https://www.stuba.sk/english/science-and-research/university-science-parks/introduction.html?page_id=9587
94. STU Scientific (2024). Spin-off spoločnosti. URL: http://www.stuscientific.sk/content/spin-off-spolocnosti
95. ŠÚ SR (2024). STAT.dat. URL: https://statdat.statistics.sk/cognosext/cgi-bin/cognos.cgi?b_action=xts.run&m=portal/cc.xts&gohome=

96. Technical university of Košice (2024). Survey - Technology Transfer Ecosystem WP2:A4, 16.10.2024
97. Technická univerzita vo Zvolene (2024). Duševné vlastníctvo a transfer technológií. URL: https://www.tuzvo.sk/sk/dusevne-vlastnictvo-transfer-technologii
98. Technical University in Zvolen (2024). Survey - Technology Transfer Ecosystem WP2:A4, 14.10.2024
99. The World Bank (2023). Developing a Functional Technology Transfer Ecosystem. URL: https://mzom.gov.hr/UserDocsImages/dokumenti/Znanost/TransferTehnologije/Transfer-tehnologije/Brosura-Developing-a-Functional-Technology-Transfer-Ecosystem.pdf
100. TREND (2023). Na Slovensku ročne pribúda zhruba sto patentov. Niektorí žiadatelia sa dopúšťajú fatálnej chyby. URL: https://www.trend.sk/biznis/rocne-pribuda-slovensku-asi-sto-patentov-niektori-ziadatelia-dopustaju-fatalnej-chyby
101. TTC CVTI SR (2024). Prieskum aktuálneho stavu vybavenosti a výkonnosti vedeckovýskumných inštitúcií v oblasti transferu technológií na Slovensku.
102. Tvardzík, J. (2023). Vedec so zákazkami od OSN: Košice dostaneme medzi najrozvinutejšie regióny EÚ. URL: https://index.sme.sk/c/23092597/saftra-photonics-odhalia-aj-najmensie-znecistenie.html
103. CVTI SR (2012). Duševné vlastnictvo a transfer technológií. URL: https://www.unipo.sk/public/media/37042/Dusevne_vlastnictvo_a_transfer_technologii_3.pdf
104. UNIZA (2023). Výročná správa o činnosti za rok 2023 – Univerzitný vedecký park.URL: https://www.uniza.sk/images/pdf/uradna-tabula/vyrocna-sprava/VS-2023/4-UVP.pdf
105. UNIZA (2024a). Univerzitný vedecký park UNIZA. URL: https://uvp.uniza.sk/en/about-us-2/
106. UNIZA (2024b). Technology Transfer Center. URL: https://www.uniza.sk/index.php/en/scientists-and-partners/cooperation/technology-transfer-center
107. UNIZA (2024). CTT UNIZA. Survey - Technology Transfer Ecosystem WP2:A4, 4.10.2024
108. UPJŠ (2024a). Výročná správa o činnosti UPJŠ v Košiciach za rok 2023. URL: https://intranet.upjs.sk/op/op.Public.php?documentid=9379
109. UPJŠ (2024b). CTT UPJŠ. Survey - Technology Transfer Ecosystem WP2:A4, 26.9.2024
110. UPJŠ (2024c). MEDIPARK. URL: https://www.upjs.sk/en/information/science-and-research/innovation-development-and-european-agenda/university-science-parks/medipark/
111. UPJŠ (2022). Spoločná konferencia CNIC a košickej SOPK spojila vedcov a biznis sektor. URL: https://www.upjs.sk/zo-zivota-upjs/konferencia-cnic-sopk-121022/
112. UPJŠ (2021a). Technology and Innovation Park. URL: https://www.upjs.sk/pracoviska/tip/en/tip-upjs/
113. UPJŠ (2021b). Center for Technology Transfer. URL: https://www.upjs.sk/pracoviska/tip/en/our-centers/ctt/
114. UPJŠ (2021c). Integrácia košických univerzít v oblasti transferu technológií (CassTech). URL: https://www.minedu.sk/data/att/c3f/21729.b73de7.pdf
115. UPJŠ (2019). TIP. Priority a náplň činnosti CTT. URL: https://www.upjs.sk/pracoviska/tip/ctt/priority/

116. Univerzita Komenského (2024): Vedecký park UK v Bratislave. Centrum transferu technológií. URL: https://cusp.uniba.sk/pracoviska/centrum-transferu-technologii/
117. USICITT (2024). Ukrainian-Slovak International Center for Innovation and Technology Transfer. URL: https://www.icit.sk/usicitt/
118. VAIA (2021). SK RIS3 2021+. URL: https://vaia.gov.sk/wp-content/uploads/2023/11/Summary-Report-of-the-EDP-to-the-Strategy.pdf
119. VAIA (2023). Slovensko, ktoré si verí. Národná stratégia výskumu, vývoja a inovácií 2023. URL: https://vaia.gov.sk/wp-content/uploads/2023/05/01_Narodna-strategia-vyskumu-vyvoja-a-inovacii_vlastny-material_V2.pdf
120. VAIA (2024a). Krajské inovačné skóre. URL: https://vaia.gov.sk/wp-content/uploads/2024/08/KISS_Krajske-inovacne-skore-Slovenska.pdf
121. VAIA (2024b). Inštitucionálne zastrešenie výskumu, vývoja a inovácií. URL: https://vvi.gov.sk/vyskum-a-vyvoj-na-slovensku/institucionalne-zastresenie-vvai
122. Vajs, M. (2013). Centrá pre transfer technológií sa snažia pomôcť výskumníkom. URL: https://vat.pravda.sk/technologie/clanok/272568-centra-pre-transfer-technologii-sa-snazia-pomoct-vyskumnikom-a-vynalezcom/
123. Visions Consulting (2023). Hodnotenie príspevku národného projektu NITT SK II. URL: https://www.opvai.sk/media/103686/zaverecna_sprava_3_cast_v5_final.pdf
124. Walasik, M. (2015). Role of a technology transfer platform in commercialization of research results. URL: https://www.researchgate.net/publication/307670799_Role_of_a_technology_transfer_platform_in_commercialization_of_research_results
125. WIPO (2024a). People at the Service of Technology Transfer. URL: https://www.wipo.int/web/technology-transfer/human-capital
126. WIPO (2024b). Intellectual Property and Technology Transfer. URL: https://www.wipo.int/web/technology-transfer
127. WIPO (2024c). Technology Transfer Organizations. URL: https://www.wipo.int/web/technology-transfer/organizations
128. Zendulková, Gavurníková, Turňa (2022). Map of Research Infrastructure as a tool of the Information System for Research, Development, and Innovation. In: Procedia Computer Science 211 (2022) 47–56