REGIONAL INNOVATION STRATEGY OF THE PODKARPACKIE PROVINCE FOR 2021-2030

RSI PODKARPACKIE

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przestrzeń otwarta

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Contents

List of the most important abbreviations

BEI – business environment institution
CF – Cohesion Fund
EDM – Electronic Documentation Management
EDP – entrepreneurial discovery process
EFDD – European Funds for Digital Development
EFEP – European Funds for Eastern Poland
EFME – European Funds for the Modern Economy
EFSD – European Funds for Social Development
ERA (Enhanced RPAS Automation) – a project supporting remote control aviation systems
ERDF – European Regional Development Fund
ESA BIC (European Space Agency Business Incubation Center) – coordinated and a network of business incubators co-financed by the European Space Agency
ESF – The European Social Fund
EU – European Union
FEnIKS – European Funds for the Infrastructure, Climate and Environment
GDP – Gross Domestic Product
GUS – Statistics Poland
ICAO – International Civil Aviation Organisation
ICT – Information and Communication Technologies
IDA – Industrial Development Agency
IT – Information Technology
LAG – Local Action Group
LGU – local government unit
NCBiR – National Centre for Research and Development
NEET (not in employment, education or training) – people aged 15-24 who do not take up work or participate in further education
NEREUS – Network of European Regions Using Space Technologies
NGO – a non-governmental organization
NRP – National Reconstruction Programme
NSRD 2030 – National Strategy for Regional Development 2030
PAIH – Polish Investment and Trade Agency
PAMISZ – Podkarpackie Academy of the Automotive Industry – Innovative Vocational Education Project
PARP – Polish Agency for Enterprise Development
PCA – Polish Classification of Activities 2007
PFR – Polish Development Fund
PFR Sp. z o.o. – Podkarpackie Development Fund
PCI – Podkarpackie Centre for Innovation

PIC – Podkarpackie Innovation Council
PIF – Podkarpackie Innovation Forum
pp – percentage point
PPP – Public-private partnership
PPS – Purchase Power Standard
PROT – Podkarpackie Regional Tourism Organization
PRz – Rzeszów University of Technology
PSC – Podkarpackie Science Center 'Łukasiewicz'
PV – photovoltaics
PZPM – Polish Automotive Industry Association
R&D – Research and Development
R&D&I – Research, Development and Innovation
RARM – Regional Development Agency of Mielec
RARR – Rzeszów Regional Development Agency
RDS – Regional Development Strategy – Podkarpackie Province 2030
RES – renewable energy sources
RFF – European Instrument for Recovery and Resilience
RFID – Radio-Frequency Identification
RIS of the Podkarpackie Province – Regional Innovation Strategy of the Podkarpackie Province for 2021-2030
RIS3 – Regional Innovation Strategy of the Podkarpackie Voivodship for smart specialization 2014-2020
ROP of the Podkarpackie Province – Regional Operational Programme of the Podkarpackie Province
RSS – regional smart specialisations
RTO – Regional Territorial Observatory of the Marshal Office of the Podkarpackie Province
SEZ – Special Economic Zone
SIA – Strategic Intervention Areas
SME – small and medium enterprises
SRD – Strategy for Responsible Development until 2020 (with a view to 2030)
SS – smart specialisation
SWOT (ang. Strengths, weaknesses, opportunities, threats) – a method of strategic analysis consisting in the juxtaposition of strengths and weaknesses as well as opportunities and threats
TRDA – Tarnobrzeg Regional Development Agency
UMWP – Marshal Office of the Podkarpackie Province
UPRP – Patent Office of the Republic of Poland
VLO – Voivodship Labor Office in Rzeszów
WSIiZ – University of Information Technology and Management in Rzeszów
WZS – Eastern Automotive Alliance
y – year

1 Introduction

The *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* (RIS of the Podkarpackie Province) is being developed at an exceptional time, when any attempts to determine the future state of the economy are extremely difficult.

The global pandemic has a varied impact on the functioning of the economy, including the industries reflected in the smart specialisations of the Podkarpackie Province.

Market changes have changed the functioning of the aviation and automotive industries, which are currently facing the need to reduce employment. Tourism and catering services, a part of the Quality of Life specialisation, also suffered. Significant difficulties have also been faced by the facilities providing medical and health improvement services. It is also difficult to accurately predict the near future of the IT industry. During the pandemic, the demand for telecommunications services increased significantly, to wit, by 50% for voice and by 40% for data services, but at the same time the number and scope of projects in different industries has been reduced. It is assumed that these changes will largely remain permanent, what stresses how important connectivity and digitisation are for the development of the economy. These positive trends are blocked by e.g. labour market conditions. According to the data of the European Commission, in Poland there are currently nearly 50 thousand vacant jobs in the information and communication industry. Reduction of said shortages would require an increase in the number of graduates by about 70%, which is not possible in a short time. The industry also requires an intensification of the work on the implementation of the artificial intelligence solutions, support for solutions related to services such as the Internet of Things, development of the blockchain technology or improvement of cybersecurity[1]. Similar problems with the shortage of personnel with appropriate competences or the need to develop key technologies are also present in other industries and areas of management.

Podkarpackie Province proved many times that despite the lower level of economic development, it is able to effectively carry out pro-innovation activities. The development and consistent implementation of the *Regional Innovation Strategy for the Podkarpackie Province for 2021-2030* can significantly contribute to even better results. The practical management has shown precisely that success is more often achieved not by those who generate very good ideas for strategies and models of action, but by those who address maybe not so groundbreaking plans, but can implement them effectlively. Modern, flexible strategic management requires constant monitoring of the environment and trends in it, as well as the adaptation of plans. The flexible approach used for the entrepreneurial discovery process requires maintaining close cross-sectoral cooperation. An effective implementation of the smart specialisation concept is likely to force the regional authorities to support the process of building public-private partnerships to increase the commitment of non-budgetary resources.

[1] Smulski J., *Rynek IT i telekomunikacji w Polsce, szanse, zagrożenia, bariery rozwoju*, IDC Poland, Warsaw 2020.

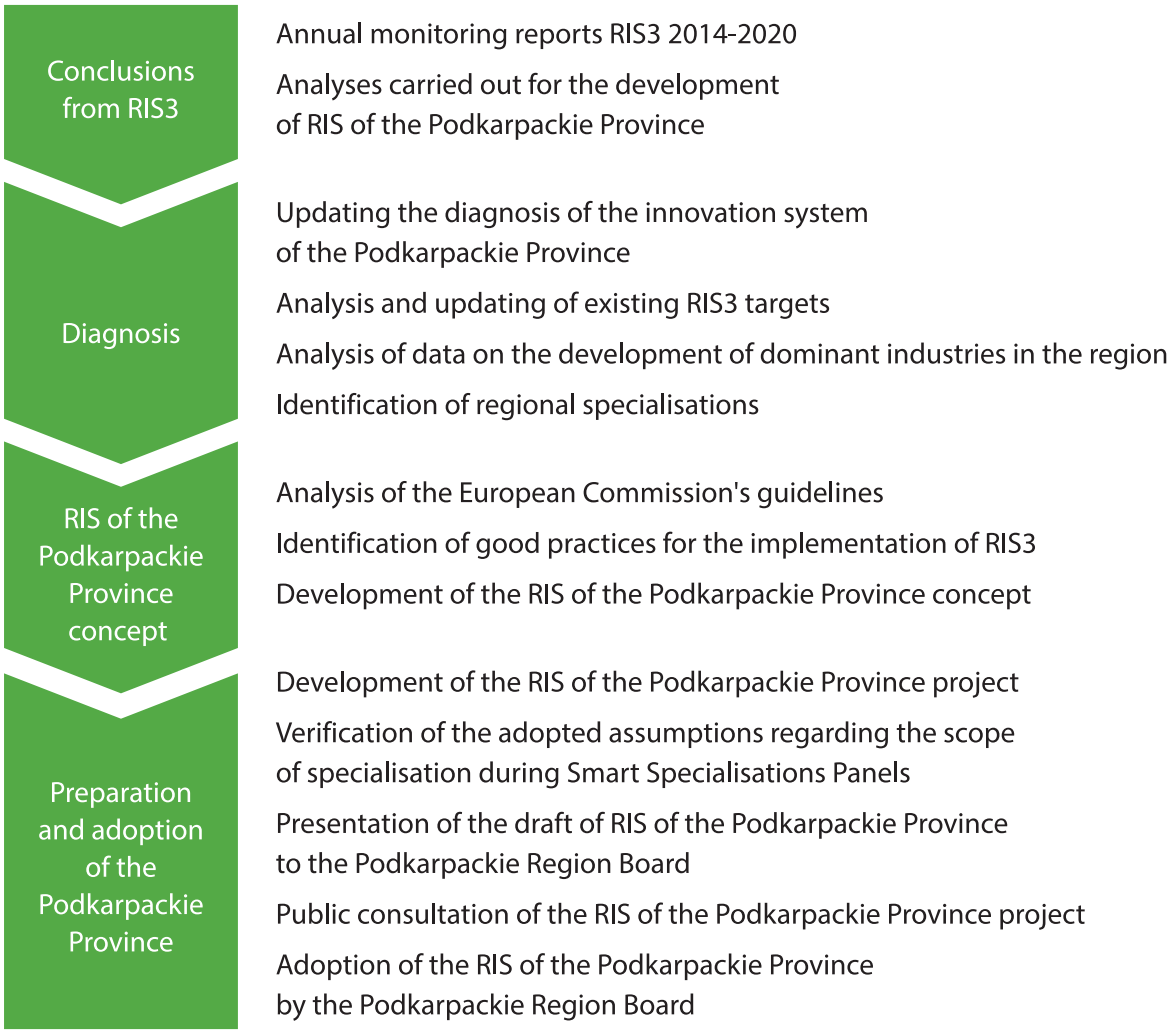
In 2020, the *Regional Development Strategy – Podkarpackie Province 2030* (RDS) was adopted as the main document defining the directions of regional policy. The adoption of this document and the forthcoming new programming period of the European Union required the development of new programming documents for the period up to 2030. One of such documents is the *Regional Innovation Strategy for the Podkarpackie Province for 2021-2030* (RIS of the Podkarpackie Province) that was adopted by the Podkarpackie Region Board as a development programme constituting a key instrument for the implementation of the priorities of the *Regional Development Strategy – Podkarpackie Province 2030* related to the development of the enterprise competitiveness, research and innovation, and in the field of human resources training for the labour market.

In order to prepare a document that would take into account all the needs of the regional economy, the RIS of the Podkarpackie Province project was prepared using an expert and participatory model. Both the experts of the RIS of the Podkarpackie Province Working Group and the regional industry experts who actively participated in the discussions related to the shape of particular specialisations during e.g. panel discussions dedicated to the smart specialisations, were involved in the development of the Strategy. The entire process was supervised by an external expert. The draft of the RIS of the Podkarpackie Province was presented at several meetings with entrepreneurs in the region. Observations and comments already voiced during these meetings helped to create a more mature version of the document that was subsequently subjected to public consultation.

2 Prerequisites for undertaking works on the RIS of the Podkarpackie Province for 2021-2030

In view of the preparations for the new financial perspective of the European Union for the years 2021-2027 the Local Government of Podkarpackie Region proceeded to review and update the strategic documents, including the development of the *Regional Innovation Strategy for the Podkarpackie Province for 2021-2030*. This document will set out the directions of regional policy conducted by the Local Government of Region in the perspective of the year 2030, in areas related to the development of entrepreneurship and innovation of the region. In order to develop a document that will comprehensively take the aforementioned scope into account, a number of actions indicated in the figure below have been taken.

Figure 1. The course of work on the RIS of the Podkarpackie Province



Source: own study

The further part of the chapter contains a presentation of the main prerequisites for the commencement of work on the RIS of the Podkarpackie Province, taking into account the main megatrends that will affect the implementation and implementation of the Strategy, as well as the EU, national and regional context.

2.1 Megatrends

The economic development of the Podkarpackie Province, as well as the development of the entire country will be affected by megatrends, i.e. phenomena causing or accelerating changes in a wide, often international scope, and covering both the social, economic and political spheres, as well as the environmental or technological ones. They affect a number of processes, including those related to production, consumption or investments.

In 2018, Deloitte experts identified six megatrends that will have the greatest impact on the shape of the global economy in the near future. These include: Industry 4.0, Circular Economy, Sustainable Finance, Talent Market, 'Silver Economy', particularly affecting the labour market, and Electromobility[2]. The biggest impact on the economic development of the province will undoubtedly be caused by the trends related to the Fourth Industrial Revolution, the transformation towards the circular economy, and changes in the labor market.

Industry 4.0 is a new concept of production using automation and robotics processes, and innovative technologies to increase its quality and efficiency and improve working conditions. It is combined with the usage of new information technologies, mobile technologies, machine learning and artificial intelligence in production processes[3]. Its development is fostered not only by technological progress, but also by the growing needs of consumers. The Fourth Industrial Revolution accelerated the processes related to the digitalisation of society, including the widespread access to the Internet. It also influenced the development of technologies related to, among others: nano- and biotechnology, virtual reality (VR) and augmented reality (AR), 3D printing, collection and storage of large amounts of data (Big Data and cloud computing), e-communications, digitally controlled warehouses, remote radio identification systems (RFID), digital twins, direct machine communication within a single enterprise (M2M) or the Internet of Things (IoT) and its successor – the Internet of Everything (IoE). It should be noted that the trend related to Industry 4.0 not only affects the economy of the Province, forcing enterprises to implement new solutions in order to maintain and develop the competitiveness of the company, but also influences (through the universality of applications) almost all spheres of social life[4].

Another factor that has an increasingly strong impact on the socio-economic development of the region is the transformation towards a circular economy. It results from the regulations adopted by the European Commission, forcing the Member States to strive for climate neutrality until 2050.

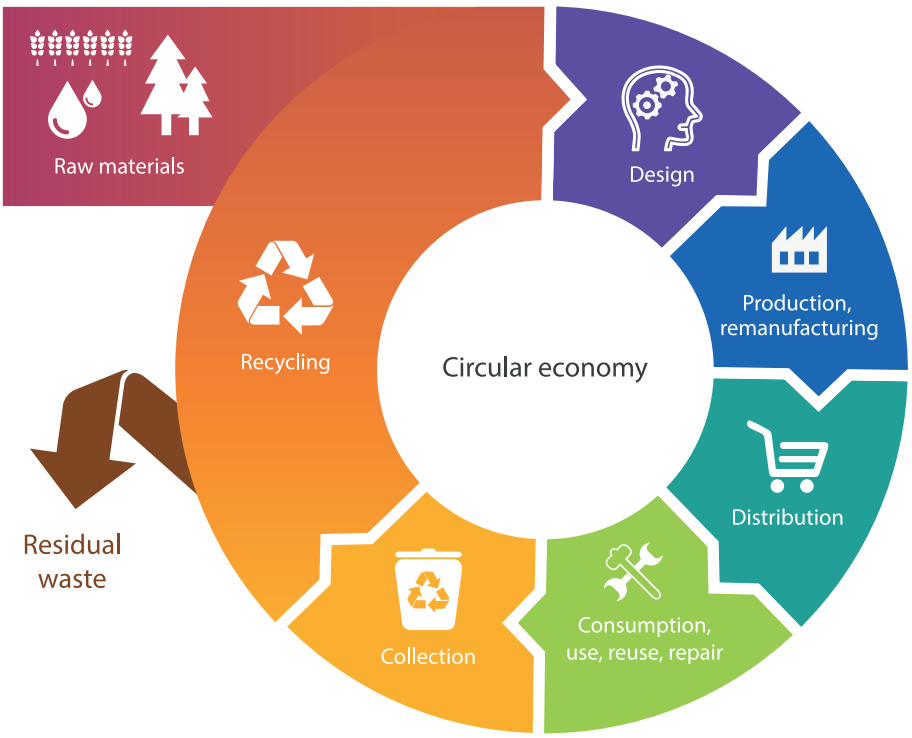
2 https://www2.deloitte.com/pl/pl/pages/press-releases/articles/megatrendy-ekonomiczne-2018.html [access 25.06.2021].

3 Piróg K., Wojnicka-Sycz E., Walentynowicz P., Sycz P., *Gospodarka województwa podkarpackiego wobec wyzwań Przemysłu 4.0*, Rzeszów 2020, pp. 23-24.

4 Ibidem, pp. 28-29.

However, it should be noted that its popularisation is also supported by the growing awareness of consumers in this area. A circular closed economy is a model of production and consumption that extends the life cycle of products and reduces waste to a minimum. At the same time, according to theory of circular economy, the product should be recycled and reintroduced into service at the end of its life cycle. The practical application of circular economy in the first phase, i.e. its implementation in the enterprise, is associated with the necessity of greater expenses, related, among others, to the adaptation of production lines, but it should eventually contribute to the increased security of the raw materials supply, reduction of production costs, and the increase of the level of competitiveness and innovation in the companies. It will also reduce the negative impact on the environment and contribute to the introduction of the products characterized by the increased durability on the market[5]. Transformation towards the circular economy is a prerequisite for creating a low-emission, resource-efficient, innovative and competitive economy on both regional and national scale[6].

Figure 2. Model of circular economy



Source: https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/economy-o-closed-circuit-definition-meaning-and-benefits-video

The last of the megatrends that will be crucial for the economy of the Podkarpackie Province is the change taking place on the labour market, including the changes related to the so-called talent market and development of 'Silver Economy'. Employers are looking for talented and qualified employees who systematically improve their competences. Such people, who possess the necessary

5 https://www.europarl.europa.eu/news/en/headlines/economy/20151201STO05603/economy-o-closed-circuit-definition-meaning-and-benefits-video [access 25.06.2021].

6 *Mapa drogowa transformacji w kierunku gospodarki o obiegu zamkniętym,* Resolution of the Council of Ministers of 10 September 2019.

knowledge and skills, and are actively involved in the process of lifelong learning constitute the social capital of an enterprise and often contribute to the increased competitiveness and innovation. They also have it easier to find a new job.

The phenomenon of the so-called 'brain drain', i.e. encouraging qualified specialists to work in other industrialised countries by providing, among others, better employment conditions or work comfort. For domestic employers, this often means fewer opportunities to undertake innovative activities or implement advanced technologies, lower productivity and sometimes even inhibition of the development of enterprises. The effects of this phenomenon are also noticeable on the national scale in the form of a reduction in consumption and tax revenue, and consequently a decrease of the economic development[7]. At the same time, the observed increase in self-employment or flexible forms of employment, the ageing of the population and technological progress also affect changes in the labour market[8]. These factors cause a so-called competence gap in enterprises, i.e. the lack of knowledge, skills and procedures enabling effective implementation of the necessary changes. In order to counteract the occurrence of such gaps, it is necessary to take measures aimed at promoting lifelong learning, as well as to adapt the education system to the real needs of employers.

2.2 The European context

Poland's participation in the EU makes it a subject to the regulatory and financial conditions adopted applicable for the associated countries. This is related, among other things, to the need to implement cohesion policy, which is the main investment policy of the European Union, and at the same time promotes sustainable territorial development. Cohesion policy regulations are framed within a seven-year timeframe, known as programming periods. In accordance with the *Regulation of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, and the European Maritime and Fisheries Fund and financial rules for those and for the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument*[9], eleven thematic objectives from 2014 to 2020 were streamlined by distilling them into five clear Policy Objectives:

1. A smarter Europe (PO 1);
2. A more environmentally friendly, emissions-free Europe (PO 2);
3. Better connected Europe (PO 3);
4. Europe with a stronger social dimension (PO 4);
5. Europe closer to citizens (PO 5).

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7 Report from the study *Drenaż mózgów czyli migracje potencjału intelektualnego* carried out by the Market Analysis Institute Pracy Sp. z o.o. in 2019 commissioned by the Polish Agency for Enterprise Development, Warsaw 2019, http://www.parp.gov.pl

8 https://www2.deloitte.com/pl/pl/pages/press-releases/articles/megatrendy-ekonomiczne-2018.html [access 25.06.2021].

9 *Regulation of the European Parliament and of the Council laying down common provisions on the European Regional Development Fund, the European Social Fund Plus, the Cohesion Fund, and the European Maritime and Fisheries Fund and financial rules for those and for the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument*, COM(2018) 375 final 2018/0196 (COD).

The Regulation also requires EU regions and Member States to comply with the so-called 'basic conditions' for cohesion policy purposes established for the 2021-2027 programming period. The role of the basic conditions is to ensure that all actions co-financed in the Member States by European funds are in line with EU policy priorities. There are fewer of them, they are more focused on the goals of a given of the Fund and, unlike the 2014-2020 programming period, must be monitored and used throughout the period. The fulfilment of these conditions will determine the possibility of incurring expenditure related to the specific objectives of the European funds.

Preparation of the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* will serve to meet the basic condition for the Policy Objective 1, i.e. 'Good governance of a national or regional smart specialisation strategy'. It will be implemented by supporting innovation, digitalisation and economic transformation, as well as by supporting the development of small and medium-sized enterprises[10]. At the same time, this objective requires the region to meet all the following seven criteria throughout the duration of the regional innovation strategy:

1. Up-to-date analysis of problems and obstacles in the diffusion of innovation, including digitization;
2. The existence of a competent regional or national institution or body responsible for managing the smart specialisation strategy;
3. Monitoring and evaluation tools to measure progress towards goals of the strateg;
4. Effective functioning of the entrepreneurial discovery process;
5. Actions needed to improve national and regional research and innovation systems;
6. Actions supporting industrial transformation;
7. Instruments of international cooperation.

Issues related to the protection of the environment and natural resources, as well as counteracting climate change are important elements of the European Union's policies and strategies developed to implement them. Such a document is, i.a. the concept of the European Green Deal developed by the European Commission to stimulate public and private investment towards a climate-neutral, competitive economy that supports social inclusion[11].

Environmental issues are also included in the dedicated Clean Planet for All strategy prepared by the European Commission. The document is a long-term strategic vision of a prosperous, modern, competitive and neutral economy (Clean Planet for all – A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy)[12]. It presents the prospect of achieving climate neutrality by supporting investments in the implementable technological solu-

10 https://ec.europa.eu/regional_policy/pl/2021_2027/ [access 31.03.2021].

11 https://ec.europa.eu/regional_policy/pl/newsroom/news/2020/01/14-01-2020-financing-the-green-transition-the-european-green-deal-investment-plan-and-just-transition-mechanism [access 31.03.2021].

12 *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions and the European Investment Bank. A Clean Planet for all A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy,* COM(2018) 773 final, Brussels, on 28.11.2018, https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52018DC0773&from=PL [access 31.03.2021].

tions, as well as by empowering citizens or taking appropriate action in the areas of industrial policy, finance and research[13].

An important document that will have an impact on the economic development of the Member States is the New Industrial Strategy for Europe which indicates the directions of industrial development that are to facilitate the digital transformation and climate neutrality in Europe. The strategy provides for measures to strengthen all actors who make up European industry, i.e. enterprises (including start-ups), research centres, entities providing services to industry, supply chains participants, and social partners[14].

RIS of the Podkarpackie Province is also a part of the scope of the Digital Europe Programme for 2021-2030. This programme aims to increase and maximise the benefits of digital transformation for EU citizens, public administration sector and businesses. It will focus on areas related to high performance computing, artificial intelligence, cybersecurity, and advanced digital skills. Its implementation will be achieved via ensuring their wide application in the economy and society[15].

2.3 National context

At the national level, the most important document in which the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030*, is the Strategy for *Responsible Development until 2020 (with a perspective until 2030)*, adopted by the Council of Ministers in 2017. This strategy is the basis for introducing changes in the area of the development management system, including the revision and update of strategic documents. It presents a new model of development that is responsible, territorially and socially balanced. One of the three main objectives of the strategy is 'sustainable economic growth based progressively on the knowledge, data and organisational excellence'[16]. At the same time, the strategy assumes a transition from supporting all sectors of the economy to individualized support for strategic sectors that have the greatest potential to strengthen the country's economic development.

Another document important for the preparation of RIS of the Podkarpackie Province, is the *Productivity Strategy* (PS 2030), one of the new integrated strategies that are part of the development management system. The main objective of the strategy is to 'increase productivity in a low-emission, circular and data-driven economy'[17]. This goal is assumed to be address by undertaking activities designed e.g. in the area of labor and human capital, including activities related to the preparation of competent staff for the needs of the digitized economy, or in the area of knowledge through the implementation of tasks related to an increase in the intensity of the utilization of knowledge and

13 https://ec.europa.eu/clima/policies/strategies/2050_pl [access 31.03.2021].

14 *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A New Industrial Strategy for Europe*. COM(2020) 102 final, https://eur-lex.europa.eu/legal-content/PL/TXT/PDF/?uri=CELEX:52020DC0102&from=EN [access 31.03.2021].

15 *Regulation of the European Parliament and of the Council establishing the Digital Europe programme for the period 2021-2027,* COM(2018) 434 final 2018/0227 (COD).

16 *Strategia na rzecz Odpowiedzialnego Rozwoju do roku 2020 (z perspektywą do 2030 r.)*, Warsaw 2017, p. 7.

17 https://www.gov.pl/web/ia/strategia-produktywnosci-2030-sp2030 [access 31.03.2021].

new technologies in the economy. The strategy places particular emphasis on the digitization and transformation of the economy towards Industry 4.0, as areas that will be of key importance for the country's economic development in the years to come[18].

RIS of the Podkarpackie Province is also in line with the provisions of the *National Strategy for Regional Development 2030* (NSRD) which is the most important strategic document indicating the directions of regional policy of Poland. Regional Innovation Strategies will primarily serve to achieve Goal 2 indicated in the NSRD, i.e. 'Strengthening regional competitive advantages' and thus contribute to the increase of the competitiveness and innovativeness of the national economy. This goal assumes intervention both in the area of supporting the innovative development of the region through e.g. improvement of the implementation of the concept of smart specialisations or the facilitation of the support of the development of both entrepreneurship and human and social capital[19]. Similar objectives are included in the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030*.

Another important document for the preparation of the RIS of the Podkarpackie Province is the *National Plan for Restoring and Increasing Resilience*, which focuses on areas related to the recovery of the economy after the COVID-19 crisis and strengthening the country's resilience to similar phenomena in the future[20].

In addition to the abovementioned documents of a strategic nature, the RIS of the Podkarpackie Province shall also take into account the provisions of the following programmes:

- *Industrial Policy of Poland*;
- *Roadmap of the circular economy*;
- *Digital Competence Development Programme for 2030*;
- *National Broadband Plan*.

2.4 Regional context

Regional Development Strategy – Podkarpackie Province 2030, the most important regional document of a strategic nature was adopted by a resolution of the Parliament of the Podkarpackie Province in September 2020. The *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* is a development programme, constituting a more detailed specification of the provisions of the RDS both in terms of strengthening the innovation and competitiveness of the region's economy, as well as training staff responding to the demand from the labour market, as well as the development of pro-innovative social capital.

The main objective of the thematic area Economy and Science, indicated in the RDS, is 'Strengthening the potential of the regional economy and increasing the share of science and research for innovative and sustainable socio-economic development of provinces'[21]. It was assumed that the

18 Ibidem.
19 *Krajowa Strategia Rozwoju Regionalnego 2030*, Warsaw 2019, p. 64-74.
20 *Krajowy Plan Odbudowy i Zwiększania Odporności (project)*, Warsaw 2021, p. 3.
21 *Strategia rozwoju województwa – Podkarpackie 2030*, Rzeszów 2020, p. 68.

above objective will be achieved by the implementation of the actions taken within the framework of priorities:

- 1.1 Science, research and higher education in support of the economy;
- 1.2 Smart specialisations of the Province;
- 1.3 Competitiveness of the economy through innovation and modern technologies;
- 1.4 Circular economy.

RIS of the Podkarpackie Province shall also take into account the activities undertaken to realize the other RDS areas:

1. In the subject area 'Human and social capital', in scope of priorities:
   - 2.1 Education;
   - 2.2 Regional health policy;
   - 2.3 Culture and cultural heritage;
   - 2.4 Labour market;
   - 2.5 Civil society and social capital.
2. In the subject area 'Infrastructure for sustainable development and the environment' in the scope of priorities:
   - 3.1 Energy security and RES,
   - 3.4 Development of information and communication infrastructure in the region,
   - 3.5 Development of business and tourism infrastructure.
3. In the subject area 'Availability of services', in scope of priorities:
   - 4.1 Improving access to public services through the use of technology information and communication;
   - 4.4 Building and developing partnerships for the development of the province.
4. In the subject area 'Territorial dimension of the strategy', in scope of priorities:
   - 5.5 Trans-regional and international cooperation.

The *Regional Innovation Strategy for the Podkarpackie Province for 2021-2030* will apply to the entire Province, including the strategic intervention areas (SIA) indicated in the RDS. In addition to the RDS, the most important document in the process of supporting innovation is the *Regional Innovation Strategy of the Podkarpackie Voivodship for smart specialization 2014-2020* adopted in 2015. It included, among others, an indication of areas that are of key importance for the economic development of the region, referred to as smart specialisations. These included: Aviation and Cosmonautics, Quality of Life and Information and Telecommunications. RIS update in 2016 added Automotive industry to the catalogue of smart specialisations.

The RIS of the Podkarpackie Province is a continuation of these documents, although it introduces the necessary corrections and modifications developed on the basis of experience from the implementation of previous strategies. The process of strengthening the region's innovation will continue to be implemented primarily by the support of slightly modified smart specialisations. At the same time, it emphasizes increasing the level of competitiveness of the entire economy of the region, also outside the areas of smart specialisations. The strategy also takes into account training of human resources, and important aspect of the economy, what makes it more comprehensive.

3 Diagnosis of the regional innovation system

The Local Government of the Podkarpackie Region attaches great importance to continuous monitoring the socio-economic situation of the region. The issues related to the functioning of the regional innovation system are part of many analyzes and reports prepared over the years, among others at the request of the Department of Regional Development of the Marshal Office of the Podkarpackie Province (MOSP).

Topics related to research and development, as well as to the innovation and competitiveness of the region are discussed in the *Regional Survey – Podkarpackie Province* reports published annually. Regional Territorial Observatory (RTO) operating in the structures of the MOSP, prepares annual reports on monitoring of the implementation of the Regional Development Strategy. In addition, the RDS monitoring reports are prepared by external experts every three years. Since 2014, a *Leading industries of Podkarpackie Province – smart specialisations of the region* analysis is published bi-anually in cooperation with the Statistics Rzeszów and RTO.

In addition to these cyclical studies, due to the need to monitor the socio-economic development of the region, both at the request of ROT and the Branch for supporting the region's innovation, detailed reports, analyses and expert opinions prepared by external research teams have been created for several years. More important studies that address issues related to the functioning of the regional innovation system include:

1. *Research on the potentials and specialisations of the Podkarpackie Province*[22];
2. *Activities of micro-enterprises in the Podkarpackie Provine*[23];
3. *Foreign trade and foreign direct investment in Podkarpackie Province in 2010-2013*[24];
4. *Entrepreneurship in the Podkarpackie Province – development direction*[25];
5. *Potential and activity of the Business Environment Institution in the Podkarpackie Province*[26];
6. *Foreign trade and foreign direct investment in the Podkarpackie Province in the years 2013-2019*[27];
7. *Economy of the Podkarpackie Province in the face of the challenges presented by Industry 4.0*[28];

[22] Bański J., Czapiewski K., Ferenc B., Mazur M., Konopski M., Solon B., *Badanie potencjałów i specjalizacji województwa podkarpackiego*, Rzeszów 2014.

[23] *Działalność mikroprzedsiębiorstw w województwie podkarpackim*, Pracownia Badań i Doradztwa „Re-Source", Rzeszów 2014.

[24] *Handel zagraniczny i bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2010-2013*, Zachodniopomorska Pracownia Badawcza, Rzeszów 2014.

[25] Klimczak T., Miller M., Wojnicka-Sycz E., Sycz P., Piróg K., *Przedsiębiorczość w województwie podkarpackim – kierunki rozwoju*, Rzeszów 2017.

[26] *Potencjał i działalność Instytucji Otoczenia Biznesu w województwie podkarpackim*, Danae, Rzeszów 2017.

[27] Piotrowski M., Thlon M., Marciniak-Piotrowska M., Thlon D., *Handel zagraniczny i bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2013-2019*, Rzeszów 2020.

[28] *Gospodarka województwa podkarpackiego*…, op. cit.

8. *Innovation system in the Podkarpackie Province*[29];
9. *Smart specialisation of the Podkarpackie Province – Information and Telecommunications*[30].

Other important sources of knowledge on the Podkarpackie Province include the evaluation reports on the implementation of the Regional Programme developed by the Voivodship Labor Office in Rzeszów (VLO) or at its request and studies created to address the needs of other institutions (Statistics Poland, ministries, the Polish Agency for Enterprise Development, banks, etc.).

In addition, for the purposes of development of the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030*, by a team of experts led by Prof. Leszek Woźniak, EngD, report on the *Assessment of investment needs of the enterprises* was prepared[31]. In 2020, the abovementioned team also prepared a *Strategic Diagnosis* for the development of RIS of the Podkarpackie Province. The synthesis of this Diagnosis, supplemented with the most recent data available when the Strategy draft has been prepared, is included in chapters 3.1-3.3. of the RIS of the Podkarpackie Province.

3.1 Characteristics of the Podkarpackie Province

3.1.1 Demographic factors

The population of Podkarpackie Province esperiences small but continuous long-term decrease. In 2019, there were 2.1 million people living in the Podkarpackie Province. It should also be noted that in comparison with many other regions of Poland, this adverse processes is less pronounced.

The visible trend indicates that the Podkarpackie Province is a relatively attractive place of residence, what may be a factor limiting the population outflux. However, decreasing (although still positive) natural growth and negative internal migration balance, may negatively affect the population and age structure of the Podkarpackie Province society in the future.

The demographic structure of the population also significantly affects the functioning of the labour market and the economy of the region. In the Podkarpackie Province, a constantly growing percentage of people over 65 years of age has been noticeable for years. In 2010 it amounted to 13.1%, and in 2019 it reached 16.9%. Despite this, Podkarpackie Province is characterized by one of the lowest demographic load index in the entire country. In 2019, there were 62.7 people of non-working age per 100 people of working age in the region, with a national average of 66.7, a best result in the country. At the same time, it is worth noting that in 2009 the situation in the province was comparatively much worse, because only three provinces had less favorable indicators. For every 100 people of working age, there were 56.7 people of non-working age, with a national average of 55 people. This means that the unfavourable processes associated with an ageing population in the region occur the slowest. It is also worth noting that in the Podkarpackie Province is also characterized by the longest

[29] Dziemianowicz W., Jurkiewicz I., Cybulska M., Bafeltowski B., Belowski M., Goliński J., Płaczek D., Tomczak N., Turosz S., *System innowacji w województwie podkarpackim*, Warsaw 2020.

[30] Jurkiewicz I., Cybulska M., Dziemianowicz W., Rafał W., Piróg M., *Inteligentna specjalizacja województwa podkarpackiego – Informacja i telekomunikacja*, Warsaw 2020.

[31] Woźniak L., Dziedzic S., Wyrwa D., *Raport z oceny potrzeb inwestycyjnych przedsiębiorstw*, Rzeszów 2019.

average life expectancy of a newborn[32], which in 2018 amounted to 83.2 years for women and 75.6 years for men with the national averages of 81.7 and 73.2 years, respectively. In 2019, the average life expectancy in the Podkarpackie Province was estimated at 83.2 years for women and 75.4 years for men, with 81.8 and 74.1 years for Poland, respectively. This might be an important result of the high quality of life in the region, that is in turn influenced by many different factors.

3.1.2 Education system

Population education is a factor that can influence the functioning of a regional innovation system. First of all, it should be noted that the level of education of the residents of the Podkarpackie Province is gradually increasing. This applies to the decrease in the percentage of people with only primary and secondary education and increase of the percentage of people with higher education, what can play an important role in the process of implementing innovation in the region.

Adverse demographic trends are visible primarily in the area of education. The smallest decrease was in primary schools – between 2011 and 2019, the number of these units in the region decreased by 16. In the Podkarpackie Province, in the school year of 2018/2019, there were 497 secondary schools, including 120 general education secondary schools (not including adult schools), 106 technical secondary schools and 81 first-cycle industry schools (replacing vocational schools). In 2010, there were 675 schools in the province, which means a decrease by about 27%. This trend results from a reduction of the number of pupils in the secondary schools from 119,557 in 2010 to 87,957 in 2018 (a decrease of about 26%). In the same period, the number of schools in Poland decreased by nearly 30% and the number of pupils by more than 25%. At the same time, the number of pupils per 1 ward in general education schools decreased from 29 in 2010 to 27 in 2018, thus reaching a level similar to the national average that in 2018 amounted to 26 people. In technical secondary schools, this ratio increased from 26 people per 1 class in 2010 to 27 people in 2018 and was higher by up to 3 people when compared with the national average. In comparison with the school year of 2010/2011, there was 31% fewer general secondary school students and 13% fewer technical secondary school students in the province. In the school year of 2018/2019, a total of 34.7 thousand pupils were educated in the technical secondary schools, while 5.3 thousand youth attended the first-cycle industry schools, what constituted 39.4% and 6% of all those educated in secondary schools, respectively. This may indicate that young people appreciate the opportunity to gain a profession.

The trend of the increased emphasis on vocational training should be assessed positively, as it will affect the education of human resources for the economy. Additionally, it may also be a factor conducive to the development of identified smart specialisations.

Education in professions that are part of regional smart specialisations is conducted in many secondary schools in the Podkarpackie Province. One of the most frequently chosen fields of study is the ICT industry. Students in these fields accounted for 12.5% of all students in schools with a professional profile located in the Podkarpackie Province in the school year of 2020/2021. However, it should

[32] Statistics Poland publishes data on estimates of average life expectancy for different age groups, in this case including persons whose age in years in a given year is 0.

be noted that the predominant teaching profile in this area was the IT technician, while employers were looking for programmers twice as often in comparison with IT specialists.

There is a decrease in the number of students in fields related to the hospitality industry, in particular in the area related to gastronomy (with the exception of cooks for whom there is still a demand). Attention is also drawn to the insufficient supply of graduates in the field of hospitality in relation to the estimated needs of the labour market.

Over 5000 students were educated in classes with an automotive profile in in the school year of 2020/2021, what means a decrease of 5.7% compared to 2013/2014. At the same time, the number of graduates is estimated to exceed the demand for employees reported by employers. The only exception, for which there is still demand, is the education in the profession of car body repairer, which at the same time is not conducted in any of schools in the Podkarpackie Province.

In the case of the electronic and mechatronic industry (related, among others, to the aviation sector), the estimated demand from the labour market significantly exceeds the number of graduates completing courses from this industry. The number of pupils in classes with this educational profile increases, but to an extent insufficient to satisfy the employment needs. This is a prerequisite for the development of education in the fields related to this industry. Despite an increase by 66% of students in the fields related to air transport, also this industry is also characterized by high demand for employees.

The need to increase education in a relevant sector is also reported by the employers from the medical industry, what could have been caused to some extent by the COVID-19 pandemic. There is a noticeable increase in the number of students educated in the fields related to the electric power industry, but in this case the number of graduates does not meet employment needs. It is estimated that every 12th person planned to be employed should have qualifications related to electric power industry. It is therefore appropriate to take steps to intensify training in this area.

There is also a need to develop education in food processing class profiles, as there is a significant (higher than 25%) decrease in the number of pupils (except for confectionery). The chemical industry, including the pharmaceutical industry, also has development potential in terms of employee absorption. Even greater opportunities in this area are visible in the sector related to social care – education in these fields is gradually decreasing, and at the same time the needs of the labour market in this area are increasing. It is also a sector with high development potential due to the progressive ageing of the population[33].

A survey of cooperation between the business sector and schools[34] has shown that 55% of employers from the Podkarpackie Region estimated that vocational training only partially responds to the needs of the labour market. Only 9.2% rated it as well-adjusted to the labour supply. This means that the level of adaptation of training courses to the requirements of the labour market is still

[33] Kawalec M., Pytko W., Kostecki B., *Kształcenie zawodowe w województwie podkarpackim w latach 2013/14-2020/21*, Voivodship Labor Office in Rzeszów, Rzeszów 2021.

[34] The survey was conducted on a sample of 1379 enterprises from the Podkarpackie Province, the Voivodship Labor Office in Rzeszów, Pytko W., Kawalec M., *Raport z badania. Współpraca biznesu ze szkołami o profilu zawodowym – w opinii podkarpackich pracodawców*, Rzeszów 2019.

insufficient, and the change process of the vocational education system needs to be continued and supported further. In the terms of alignment between the current education and the demand from employers, the local schools were rated best by entrepreneurs from Krosno, while the institutions from the Przemyśl district was ranked last. In the opinion of employers, students graduating from technical schools have the highest chances of employment (37.1% of respondents indicated technical graduates were employed in their company within 5 years from the graduation). There is also a relationship between the size of the company with a tendency to employ graduates – the larger the company, the more often they gave positive answers in this regard. At the same time, employers draw attention to the fact that schools prepare students better in terms of acquiring theoretical knowledge rather than practical one (this applies to both industry schools and technical schools), at the same time assessing the social competences of graduates as satisfactory.

Despite assessing vocational training programmes as only partially aligned with the needs of employers, few of them are interested in cooperation with schools. Only a third of entrepreneurs use the potential of cooperation with schools with a professional profile in the field of human resources preparation. Large companies (employing up to 999 employees) with a production profile showed the highest tendency to undertake such activity. The survey respondents largely agreed that the need to cooperate with schools results primarily from the difficulties in finding employees (for more than 56% of respondents it was a way of preparing future employees in accordance with the needs of the prospective employer). The most common form of cooperation was admission of students to apprenticeship and internship programs. At the same time, it should be noted that as many as 42.9% of employers train students without taking giving the apprenticeship programme much thought. This may be due to the fact that this form of employment scheme is not aligned with the needs of employers. The survey showed the continued need to support entrepreneurs in starting cooperation with educational institutions (a problem reported by 27.8% of respondents), mainly in the form of assistance in reaching appropriate schools, what includes mediation in establishing contacts. Respondents also declared the need to be able to influence the types of courses available so that the latter are better aligned with the market qualifications sought by the employers and with the employee acquisition process[35].

Thanks to the involvement of entrepreneurs in an active cooperation with schools, it will be possible to better adapt the vocational education system to the requirements of potential employers.

An important factor of the adaptation of the education system to the challenges of the labour market is undoubtedly the quality of vocational guidance provided in educational institutions. Training of the future economy participants begins, in fact, at the level of primary schools, as the first choices regarding the fields of further education are made there. The vocational counselling is all the more important because some young people decide to continue their education in vocational schools when they are still attending primary schools. Guidance supporting such decisions should be well informed and based not only on students' interests and predispositions, but also on analyses of the labour market needs. It is therefore important to develop entrepreneurship education in primary and secondary schools. However, the availability of high-quality career guidance is also important.

[35] Ibidem, pp. 4-50.

Research carried out by Voivodship Labor Office in 2018 and related to the professional counseling in educational institutions of the Podkarpackie Province[36] indicated that although there is no problem with the availability of people who may perform such roles, but such people generally have little experience in this field and often lack appropriate facilities for work. 14% of all vocational counsellors did not have any education related to counseling and were delegated to perform this function by their suprvisors due to the statutory obligations of the latter. In addition, 15% of the surveyed advisors did not have any experience in this area, and as many as 51% had only moderate experience. It is also worrying that the majority of people performing this function did not have the quaifcations to perform professional counseling tests (81.3% of respondents) and declared lack of knowledge of methods used in this field (76.6%).

Poor quality of career counselling may lead to untapped potential and students' skills or their inadequate orientation, and as a result, to make improper professional decisions[37]. It may also result in the occurrence of a surplus of students in general education schools or in courses that do not provide good employment opportunities. Therefore, it is important to take actions that improve the quality of the support provided in the field of professional counseling. One of such activities is the project of the Podkarpackie Academy of Vocational Counselling, carried out by the Podkarpackie Voivodship Labor Office in 2018 and 2019. The project included education courses for 120 school professional advisors, aimed at development of their knowledge and experience in professional counseling.

In the context of education, it should be noted that the value of the NEET index for the Podkarpackie Province, i.e. the percentage of people aged 15-24 who do not take up work or participate in further education is generally unfavourable. In 2019, it was equal to 10.9%, thus being one of the highest in Poland. At the same time, compared to 2016, the region recorded the highest decrease of this indicator in the country (by 4.7 percentage points)[38], what suggests that the professional activity of people in this age range, formal education and participation in professional training is increasing.

An important factor that affects the level of innovation in the Podkarpackie Province are Universities that play primarily an educational, scientific and cultural role. The functions fulfilled by the education are also reflected in relations between various elements of the innovation system.

In the academic year 2019/2020, there were 16 universities in the Podkarpackie Region, including University of Rzeszów, Rzeszów University of Technology and 14 universities (state and private). In 2019 a total of 45.9 thousand students were enrolled the in universities located in the Podkarpackie Province.

[36] To wit, in 815 primary schools and/or junior high schools (i.e. in 77.3% of the existing ones), 37 general secondary schools (i.e. in 30.8% of the existing ones), 82 upper secondary schools with a professional profile (i.e. in 78.1% of the existing ones), 9 psychological and pedagogical centres and 15 special education centres or other types of special institutions.

[37] *Doradcy zawodowi pracujący w szkołach i placówkach oświatowych na terenie Województwa Podkarpackiego – rozeznanie sposobu realizacji doradztwa zawodowego wśród uczniów*, Voivodship Labor Office in Rzeszów, Rzeszów 2018.

[38] *Przegląd regionalny. Województwo podkarpackie 2019,* Centre for Research and Statistical Education of the Statistics Poland in Jachranka, Rzeszów 2020, p. 150.

In the analyzed period, the number of students in the Podkarpackie Province also decreased systematically due to the demographic changes, but also because of the migration of young people to other regions (mainly to the Małopolska Province) in order to undertake higher education. The number of graduates decreases at a slightly slower pace, as the duration of studies alone makes adverse changes visible only from a certain temporal perspective. In the future, despite the improved structure of the society's education, this may result in a shortage of employees with higher education. This is likely to be a factor hampering the development of the economy, especially since some industries (such as IT) indicate difficulties in employing people with an appropriate education. The solution may be to intensify the development of the lifelong learning model.

In the Podkarpackie Province, in the years 2014-2018, the number of students in environmental sciences decreased by 65% (compared to the national average decrease of 58.9%), in ICT by 25.5% (with a nationwide average decrease of 9%) and biological by 5.8% (with an national average increase of 35.2%). The decrease in the number of engineering and technical faculty students was smaller than the average for country, as it fell by 21.9% (compared with 27.3% nationwide). Podkarpackie Province also experienced an increase of the number of students in medical faculties by 5.1% compared with the nationwide increase by 4.4%.

The largest concentration of students occurs in Rzeszów, as the majority of the largest regional universities are located in the capital of the Province.

Within individual universities, the key elements of research and development infrastructure were identified. The Rzeszów University of Technology is a leader among the facilities equipped with the specialized laboratories (176), followed by the University of Rzeszów, where 10 research centers were identified, each of them housing between 4 and 13 specialized laboratories.

Elements of research and development infrastructure are also present at the University of Law and Public Administration in Rzeszów, the University of the Information Technology and Management in Rzeszów, the State Vocational College in Tarnobrzeg, Jan Grodek State University in Sanok and the Carpathian State College in Krosno.

The University of Rzeszów and the Ignacy Łukasiewicz Rzeszów University of Technology were included in the 2020 University Ranking 'Perspektywy' among the 100 evaluated academic universities (occupying places 53-60 in the ranking) and the University of Information Technology and Management in Rzeszów (occupying places 71-80). The ranking also included the University of Law and Public Administration in Rzeszów, however, the university did not complete the survey, therefore its position in the ranking cannot be taken into account. The University of Information Technology and Management in Rzeszów, also achieved 15th place among 50 non-public universities. The ranking of state vocational schools, which included 34 universities, included the following institutions: the East European State Higher School in Przemyśl (9th place), Jan Grodek State University in Sanok (11th position), Carpathian State College in Krosno (19th place), Stanisław Tarnowski University in Tarnobrzeg (33rd place). Places in the ranking illustrate the overall potential of the universities relative to other institutions in a given category in the entire country.

In terms of innovation, Rzeszów University of Technology was ranked 12th in the ranking of university ranking of the number of granted protection rights that included 50 Polish institutions. In terms

of scientific effectiveness, Rzeszów University ranked 33rd, and Rzeszów University of Technology ranked 42nd out of 50 universities included in the ranking.

The relatively low positions of the universities of the Podkarpackie Province in the university rankings may be one of the reasons of the gradual outflow of young people to other regions. Customization of the program of education so that it is aligned with the needs reported by employers, and consistent cooperation in this area with entrepreneurs may be one of the ways to stop the outflux of young people who get education in other provinces. At the same time, it may be a way to increase the absorption of already educated employees by the Podkarpackie labour market. This is all the more important as graduates of universities in the Podkarpackie Province, whose education, qualifications and competences do not align with the requirements of potential employers, are increasingly migrating from the region.

The participation of adults in lifelong learning is also an important issue from the point of view of the education system. However the Podkarpackie Province records the lowest value of the index of people aged 25-64 developing qualifications and competences through e.g. participation in training. In 2019, it amounted to 2.4% (an increase by 0.4%), while the average for the country was twice as high[39]. At the same time, it should be noted that employers see a need for lifelong learning among employees. In a study carried out on behalf of the Voivodship Labor Office in Rzeszów in 2017, more than half (54.3%) of entrepreneurs from the Podkarpackie Province noticed the benefits resulting from the participation of their employees in the process of retraining and qualifications improvement. The need for constant learning most often resulted from the specific character of the industry the enterprise was a part of, as declared by the 51.7% of the entrepreneurs included in the study. In addition, they declared that 35.4% of their employees in the year before the participation in the study took in lifelong learning, noting, however, that this most often took place on the initiative of the company's management. Employee participation in all kinds of training and courses is treated by employers as a kind of investment aimed at the development of the competitiveness of enterprises[40].

In the light of changing labour market conditions, lifelong learning will become increasingly important. It will therefore be important to support this process by e.g. raising public awareness of the need for active participation in lifelong learning.

3.1.3 Economic development of the Province

In addition to demographic factors, economic factors are also important for the development of the region's economy. Gross domestic product (GDP) is a metric most commonly used to assess the level of its development.

According to Eurostat, in terms of GDP per capita calculated in accordance with the purchasing power standard (PPS), the Podkarpackie Province occupies a distant, 224th position among 241 regions

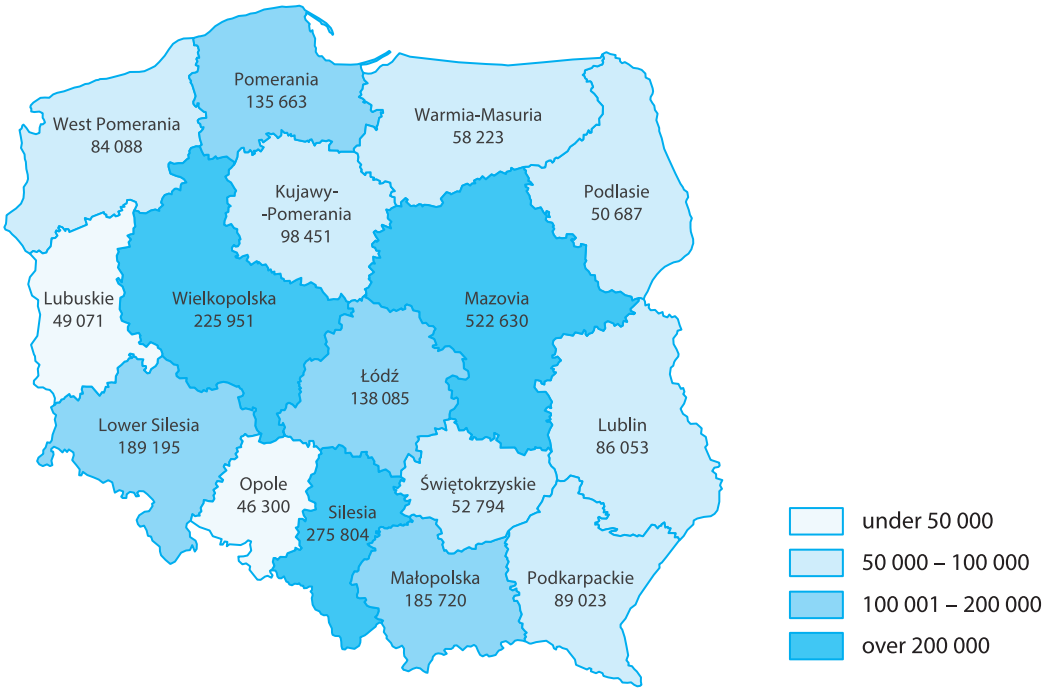
39 *Przegląd regionalny*…, op. cit., p. 152.

40 Tkocz-Wolny K., Kempa A., Szymala W., Kisiel E., *Kształcenie ustawiczne na Podkarpaciu*, Grupa BST, Rzeszów 2017, pp. 8-11.

of the European Union with 15,100 PPS, what amounts to 50% of the EU average. Poland's GDP per capita in 2018 amounted to 71% of the EU average, which gave it the 19th place among all EU Member States. It should be noted however, that the GDP growth in the Podkarpackie Province is quite rapid when compared to other EU regions, as in 2004 the GDP per capita for the Province was only 36% of the EU average.

In 2018, the value of GDP generated in the Podkarpackie Province amounted to PLN 83 billion. It should also be noted that the region was characterized by a positive dynamics of growth of this indicator, the results of which were similar to the values of this metric for the entire country. Preliminary estimates made by the Statistics Poland for 2019 show a further increase in the value of GDP, which is estimated at PLN 89 billion (7.2% higher in relation to the preceding year).

Figure 3. Total Gross Domestic Product (current prices) by province in 2019 [PLN million] – preliminary estimates

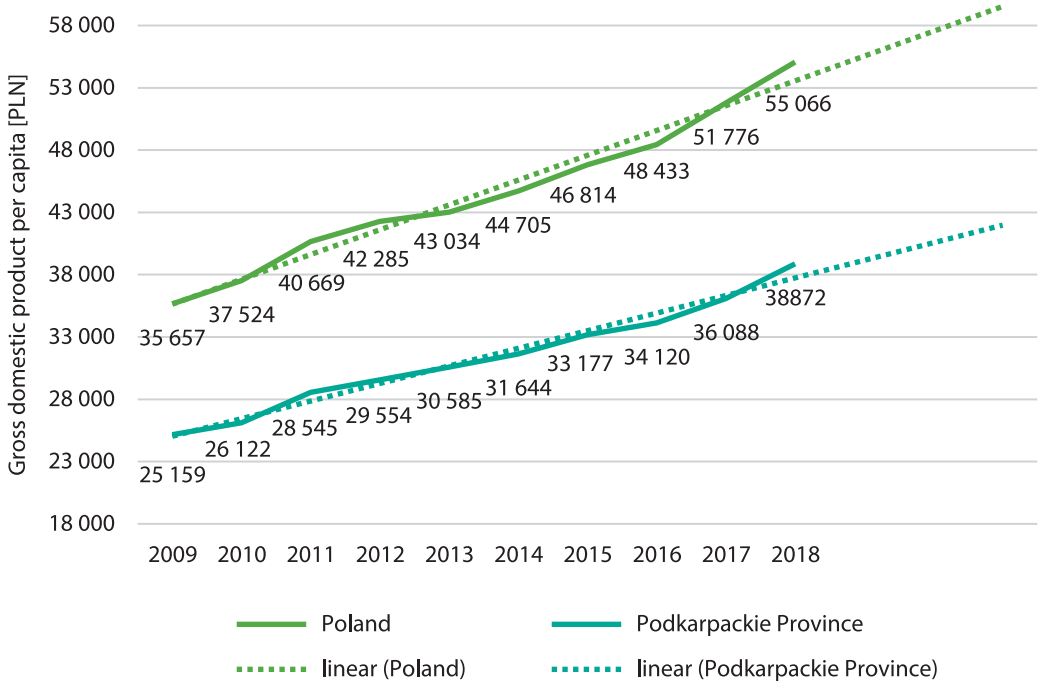


Source: *Report on the state of Podkarpackie Province for 2020*

GDP per capita in the years 2009-2017 placed Podkarpackie Province among the least developed Polish regions. In 2018, the Province recorded the highest increase in GDP, equal to 7.7% in comparison with 2017, with the average for the country amounting to 6.3%, and the minimum value being 3.9%, recorded for the Lublin Province. In the following year, these dynamics has remained at a similar level.

The dynamics of the growth of GDP per capita in the years 2009-2017 ranks Podkarpackie Province 9th among all Polish Provinces, which means that the region makes a good use of development opportunities.

Figure 4. Gross Domestic Product per capita in Poland and Podkarpackie Province in the years 2009-2018



Source: own study

Low incomes are an important factor that may determine the possibilities of development of the province. However, from the point of view of the assessment of the region's economy in the context of innovation it is more prudent to use the productivity of the economy measured by the gross value added.

In terms of productivity of regional economies of the country, Podkarpackie Province occupied penultimate place in the 2017 ranking, indicating 74.2% of the national average gross value added per 1 employee.

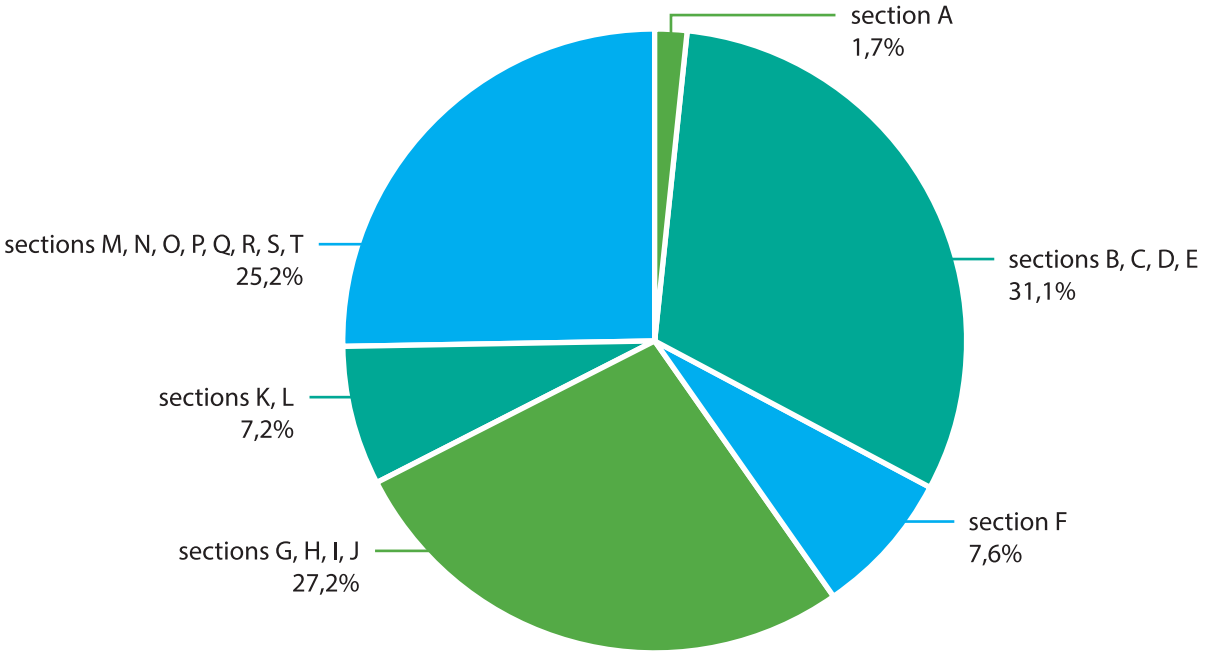
Data on preliminary estimates of gross added value per 1 resident in 2018 indicates that the Podkarpackie Province indicated 74.9% of the average value for the entire country, which allowed it to move one rank up in comparison with the preceding year.

During the analysis of the economic development of the province, attention should be paid to uneven pace of development at the subregions level. This is illustrated, by e.g. the value of GDP at the subregions level within the Podkarpackie Province. Rzeszów and Tarnobrzeg subregions are by far the most dynamically developing (37.5% and 30.3% of the total GDP respectively), while the Przemyśl subregion is the least developed (only 13.5% of the share in the regional GDP). Similar conclusions can be drawn by analysing the gross value added at the level of individual subregions.

In the region, there is a significant variation in productivity depending on the type of activity. Industry has the largest share in the creation of gross value added in the Podkarpackie Province. In 2018, it amounted to 31.1%, thus enabling it to take 5th place in the country. At the same time, it was 5.3 percentage points higher than the average in Poland. It shows a high degree of industrialization of the region. Agriculture, forestry, hunting and fishing accounted for the smallest share of gross

value added – 1.7%. It should be noted, however, that at the same time, people employed in the agriculture dominate in the structure of workers in the national economy – in 2017 they constituted 30% of all workers[41]. In the case of industry, the predominant industrial processing, which accounted for 27% of the gross value added generated in 2018 in the Podkarpackie Province.

Figure 5. Regional variation in productivity in the Podkarpackie Province according to types of activities in 2018[42]



Source: own study

In the Podkarpackie Province, as of the end of 2019, there were 181,107 active enterprises, of which 96% belonged to the private sector. Compared to 2000, this means an increase of 41.1%. Among private sector entities, the vast majority (77.5%) consisted of natural persons conducting business activity. Entities from the Podkarpackie Province constituted 4% of the total number of entities registered in the Register of National Economic Entities (REGON).

The structure of business entities by size classes in the Podkarpackie Province is dominated by micro--enterprises that amount to slightly more than 96% of the total number, then small enterprises (3%), medium-sized enterprises (0.69%) and large enterprises (0.016%).

41 *Przegląd regionalny*…, op. cit., p. 255.

42 Section A – agriculture, forestry, hunting and fishing; sections B, C, D, E – industry, including industrial processing; Section F – construction; sections G, H, I, J – trade; repair of motor vehicles; transport and warehouse management; accommodation and catering; information and communication; sections K, L – financial and insurance activities; real estate services; sections M, N, O, P, Q, R, S, T – other services.

Table 1. Entities of national economy by size classes (as of the end of 2019)

Territorial unit	By size classes – number of employees					
	total	0-9	10-49	50-249	250-999	1000 and more
Podkarpackie Province	181 107	173 965	5 707	1 253	152	30

Source: own study

In terms of numbers, entities dedicated to wholesale, retail, and repair of motor vehicles are best represented (23% of entities), followed by construction (14.7% of companies), industrial processing (9.5% of enterprises) and professional, scientific and technical activities (8.9% of entities).

Investment attractiveness is one of the factors that have a significant impact on the economic development of the region. It consists of many elements, including locational values, that enable achieving the investor's goals, such as achieving sales revenues or profitability of the investment. In the study carried out on behalf of the Polish Investment and Trade Agency in 2017, the Podkarpackie Province was ranked 243rd out of 275 EU regions (one of the lowest investments compared to other regions of the country), thus it was classified as a region with low investment attractiveness (class E)[43]. At the same time, it should be noted that a number of measures are being taken to improve this situation. The transport accessibility of the Province has systematically been increased, by e.g. extension of the A4 motorway, thus ensuring good communication between the provinces of Southern Poland and strengthening cooperation between enterprises from these regions. Similar possibilities will be provided by the completion of the S19 expressway, which will increase transport accessibility within the north-south system. Investment attractiveness is also increased by Special Economic Zones located in the province, such as Euro-Park Mielec and Euro-Park Wisłosan, as well as industrial or scientific and technological parks located in Mielec, the municipality of Leżajsk, Rzeszów, Jasionka and Tarnobrzeg, or business incubators. At the same time, due to the large discrepancy between the Podkarpackie and more attractive regions, this area will require further support.

3.1.4 Labour market

Podkarpackie Province is characterized by unfavourable rates of professional activity of residents compared to the country average. The share of employed people in Poland is 3% higher than in the province. In addition to the higher percentage of unemployed, the higher percentage of economically inactive people in Podkarpackie Province is higher by more than 2%. This may be caused, among other factors, by the degree of enterprise development and the structure of the economy with a large share of agriculture.

[43] Godlewska-Majkowska H., Pilewicz T., Turek D., Żukowska J., Zarębski P., Czernecki M., Typa M., *Atrakcyjność inwestycyjna regionów 2017. Podkarpackie Province*, Warsaw 2017, p. 9.

Table 2. Professional activity of residents of Poland and Podkarpackie Province in 2019

Unit	Professionally active people						Economically inactive	
	total		working		unemployed			
	thousands of people	%	thousands of people	%	thousands of people	%	thousands of people	%
Polska	17 019	56,2	16 461	54,4	558	1,8	13 264	43,8
Podkarpackie	877	54,1	832	51,4	45	2,8	743	45,9

Source: own study

Professional advisors play an important role in the process of professional activation. This is one of the most frequently needed and sought-after forms of support by economically inactive unemployed[44].

Podkarpackie Province is also characterized by a high unemployment rate compared to other regions of the country. In 2020, it was 9.1% in the province, with an average of 6.2% for Poland. The higher unemployment rate occurred only in the Warmia-Masuria Province where it amounted to 10.1%. A comparable indicator was found in the Kujawy-Pomerania Province (8.9%), Świętokrzyskie Province (8.5%) and Lublin Province (8.2%). It should be noted that the value of this indicator has been systematically decreasing for several years (in 2014 it amounted to as much as 14.6%). In 2020, most likely as a result of job cuts caused by the economic crisis related to the COVID-19 pandemic, this positive trend reversed.

Compared to other regions in the country, there are relatively few job posts – in 2019, 26.9 thousand of them were created, ranking the Province 10th in Poland. On the other hand, it is still an increase of 33.1% compared to 2016 and a number significantly higher than the number of closed jobs (12.7% in 2019).

In the Podkarpackie Province, there was also an increase in average employment – in 2019 it reached the value of 450,605 people. The largest employment is in the industrial sector – 31.9%, followed by trade and repair of motor vehicles (15%), and education (12.6%). The employment structure has not significantly changed over the last few years.

In addition to the high unemployment rate compared to the rest of the country, Podkarpackie Region is also negatively distinguished by one of the lowest values of the average wage in Poland. In 2019, it amounted to PLN 4388.16, what constituted 84.7% of the country average and was at the same time one of the lowest (the lower value is recorded only in the Warmia-Masuria Province). It should be noted that despite the systematic increase of the level of average remuneration, its value does not allow Podkarpackie Region to change its position in the ranking of provinces.

[44] Pytko W., Kawalec M., *Bierni zawodowo na Podkarpaciu. Charakterystyka i możliwości aktywizacji*, Voivodship Labor Office in Rzeszów, Rzeszów 2019, p. 189.

An important issue from the point of view of the labour market are the expectations of entrepreneurs towards potential employees. The conducted research in the scope of qualifications and professional competences expected by employers shows that one of the most important requirements imposed by entrepreneurs on candidates for work is having professional experience (56.5% of respondents representing SS industries and 47% from outside SS stress this requirement). Slightly less important to the formal confirmation of the profession (it is expected by 52.2% and 41.5% of employers, respectively). It should be noted that 42.3% of representatives of companies not belonging to regional specialisations do not expect such formal confirmation from candidates. The level of education is considered less important by employees, and as many as 36.8% did not declare any expectations in this regard. The analysis of the so-called 'hard competences' desired by potential employees indicates a differentiation between SS companies and non-SS companies. For the former, important skills include: computer software (43.5% of indications), customer service (26.1%), and machine and device operation (23.9%). The second group indicated the use of machinery and equipment (32.3%), activities other than the use of machinery and equipment (27.9%), and a possession of a driving licence (19.8%). Among the soft competences, entrepreneurs put the highest value on personal competences, including willingness to work (most often indicated by both SS representatives and other employers), diligence, reliability or professionalism[45]. Due to the significant impact the improvement of qualifications and competences by employees has on the situation on the labour market, this area will require further support.

3.1.5 Foreign trade and investment in the region

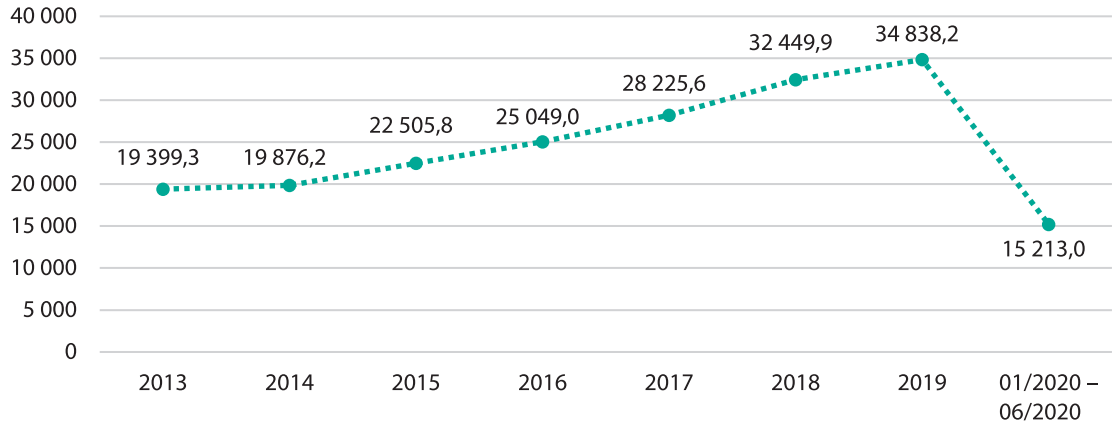
The development of trade is one of the factors playing an important role in the economic development of both the country and the region. Thanks to the constant exchange of raw materials, goods and services, the resources necessary to ensure the proper functioning of the economy are created.

The level of development of foreign trade is mainly evidenced by the values of indicators of trade in goods, including mainly exports and imports. In the years 2013-2019, a constant upward trend in both exports and imports of goods was observed in the Podkarpackie Province. At that time, exports of goods from the region increased from PLN 19.4 billion to almost PLN 35 billion. This means an increase of almost 80% over a period of 7 years, meaning an bit more than 10% average annual increase.

In 2020, a collapse of this trend is visible, what was largely caused by the COVID-19 pandemic and the resulting introduction of socio-economic restrictions.

[45] Pytko W., Kawalec M., Kostecki W., *Zapotrzebowanie na zawody oraz kwalifikacje i kompetencje na lokalnych rynkach pracy w województwie podkarpackim- wpływ pandemii COVID-19- edition 2020 (report on examination),* Rzeszów, 2020, p. 6-11. The survey was carried out on a sample of 11 455 entrepreneurs

Figure 6. The value of exports for the Podkarpackie Province in the period 2013-2020 [in PLN billion]



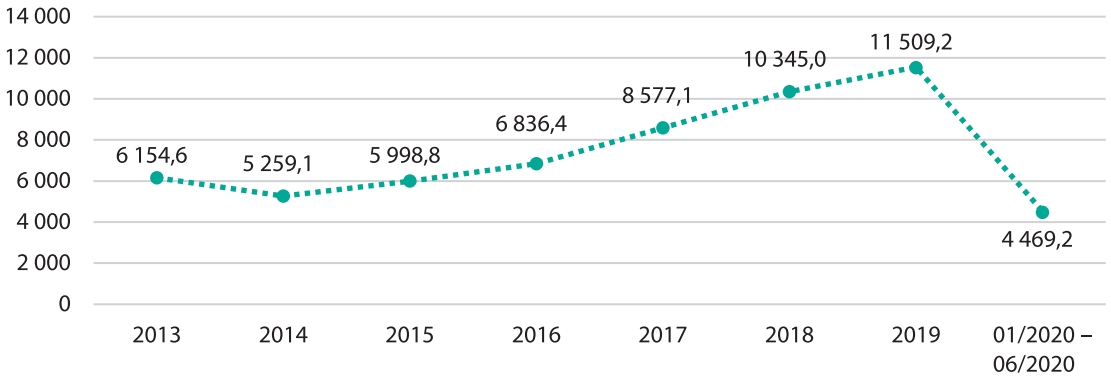
Source: *Foreign trade and foreign direct investment in the Podkarpackie Province in the years 2013-2019*, Rzeszów 2020

In 2019, enterprises from the Podkarpackie Region exported goods worth PLN 34.8 billion in total, which was the 8th result in the country. At the same time, taking into account the value of exports in terms of the number of entities registered in REGON, this result is even more favorable, because with a value of just over PLN 192 thousand, it allowed the region to be ranked 5th in the country[46].

Linear growth in 2013-2019 could also be observed in the case of the level of imports of goods to the Podkarpackie Province, which in 2019 reached the level of just over PLN 23 billion. However, as in the case of exports, 2020 brought a collapse of this trend.

The region also displays a consistent surplus of the exports over imports, referred to as the positive balance of foreign trade that has doubled in the period of 2014-2019.

Figure 7. Balance of foreign trade for Podkarpackie Province in the period 2013-2020 [in PLN billion]



Source: Foreign trade and foreign direct investment in the Podkarpackie Province in the years 2013-2019, Rzeszów 2020

46 *Handel zagraniczny i bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2013-2019, Op. cit. s. 6*

This phenomenon may indicate that the region imports rawmaterials and unprocessed products that are usually characterised by a lower unit price, and exports goods highly processed goods with a higher market value. Even in the difficult period associated with the occurrence of the pandemic, the Podkarpackie Province achieved a positive foreign trade balance of almost PLN 4.5 billion[47].

The restrictions introduced in 2020 due to the pandemic – primarily those related to transport and travel – prevented trade in services. There has also been a decline in demand for some consumer goods. Global trade in goods declined by 13-32% in 2020 The most rapid decline in trade is seen in sectors with complex value chains such as electronics and automotive[48]. Disturbances in the functioning of global supply chains have resulted in a decrease in the dynamics of trade. Difficulties in the transport of goods have exposed a weakness of the current world trade, namely the excessive dependence of Polish entrepreneurs on supplies from a single source, in particular from China[49]. It is also an opportunity to rebuild supply chains using domestic production and thus significant shortening thereof.

The influx of foreign capital is another factor contributing to the increase of the economic development in the region. At the same time, it is one of the manifestations of the internationalisation of enterprises and thus the strengthening of their competitiveness.

The number of national entities with foreign capital in the Podkarpackie Province in 2018 amounted to 738, which allowed it to take the 10th place in Poland. Taking into account the value of this indicator per 10,000 inhabitants, the region achieved a result more than twice lower than the average for Poland. It should be noted, however, that it was also the highest value among the Polish eastern Provinces.

In 2018, the amount of foreign capital accumulated in Subcarpathia Region amounted to nearly PLN 2991.9 million, which was only approx. 1.5% of the value for the country. Also the value of the foreign capital per capita is relatively low in the group of inhabitants in production age, amounting to barely 2268 PLN. Countries that most often invested in the Podkarpackie Province were Germany and Great Britain.

Entities with foreign capital operating in Podkarpackie Region achieved in 2018 net financial result of PLN 2131 million, what ranked 9th in the country and at the same time ranked 1st among the provinces of Eastern Poland.

The data indicated above may indicate a relatively low (compared to the country) investment attractiveness of the province for foreign investors. Given the importance of internationalisation of enterprises in order to increase their level of competitiveness, further efforts may be needed to attract more foreign investors to the region.

47 Ibidem, p. 21.

48 Report from the study *Monitoring trendów w innowacyjności Raport 8* przeprowadzonego przez A. Tarnawę, P. Chabiora, J. Łapińskiego, M. Nieć, A Kosińską, J. Orłowską, R. Zakrzewskiego w 2020 roku na zlecenie Polskiej Agencji Rozwoju Przedsiębiorczości, Warsaw 2020, http://www.parp.gov.pl

49 *Handel zagraniczny oraz bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2013-2019*, op. cit. p. 50.

3.1.6 International cooperation

International cooperation is, in addition to the foreign trade, an important factor of increasing the level of competitiveness of the region, thus contributing to its economic development.

For many years, the Local Government of Podkarpackie Province has been supporting the development of international cooperation through the implementation of various instruments supporting the internationalization of the enterprises from Podkarpackie Province, both in the form of co-financing participation in the international trade fairs, organizing or participating in various economic missions, as well as by establishing partnerships that make it easier for enterprises or universities to implement international research projects or build networks of contacts. Such instruments are, e.g. own projects of the Local Government funded by ROP of the Podkarpackie Province 2014-2020, including e.g. projects *Economic promotion of the Podkarpackie Province* or *Smart specialisations – a tool for increasing the innovation and competitiveness of the Podkarpackie Province*. The Podkarpackie Province is also an active participant in the international projects related to the area of e.g. creating and implementing the Regional Innovation Strategy (the *Public policy Living Lab* project, the result being the implementation of the so called Metapanel, which is a forum for stakeholders of all Podkarpackie smart specialisations, into the entrepreneurial discovery process developed for the region.

Enterprises from the Podkarpackie Province use a variety of tools to support the establishment of international cooperation. In addition to registration in the databases of Polish exporters, they take part in economic missions and fairs (both as participants and exhibitors). They also engage in the activities of of the international research consortia, in particular within the Horizon 2020 programme. As a part of this programme, entities from the Subcarpathia Region participated in the implementation of 46 projects with a total value of EUR 10.7 million, 35 of which were run by consortia, including enterprises from the Podkarpackie Province. The majority of acquired projects are related to the aviation and cosmonautics, a key specialisation of the province[50].

Table 3. List of projects of the Horyzont 2020 programme from the Podkarpackie Province taking into account smart specialisations of the region (BEIs, enterprises)

Smart specialisation	Number of projects	Co-financing [thousand EUR]	Value of projects [thousand EUR]
Aviation and Cosmonautics	16	4 076,5	5 674,6
No specialisation	16	2 223,1	3 043,7
Automotive	4	689,4	944,7
Information and Telecommunications	5	411,5	587,8

Source: *Foreign trade and foreign direct investment in Podkarpackie Province in the years 2013-2019*, Rzeszów 2020

This is the result of e.g. joint activity of entities from the Podkarpackie Region with the Łukasiewicz Research Network – Institute of Aviation as part of the Clean Sky 2 (CS2) institutional partnership,

50 *Foreign trade and foreign direct investment in Podkarpackie Province in the years 2013-2019,* op. cit. s. 95-96

that ws joined in 2017 by Local Government of Podkarpackie Region, making it the only participating Province in Poland. This partnership was established under the Horizon 2020 programme as a joint venture between the European Commission and companies from the European aviation sector. Its aim was both to improve the competitiveness of European industry and to reduce the negative impact of aviation on the environment. The structure of the partnership means that interested parties were given great opportunities to develop international cooperation, in particular to establish contact with European companies in the aviation sector.

The Small Air Transport – Affordable Manufacturing (SAT-AM) project is the largest project implemented under Horizon 2020 in the region, and involves as many as five companies from Podkarpackie Province (EUROTECH, SZELTECH, PW METROL, ULTRATECH and Polskie Zakłady Lotnicze Sp. z o.o.). The aim of the project was to develop the innovative design processes and production technologies to increase the flight safety of the aircrafts while reducing the production costs. In December 2020, Polskie Zakłady Lotnicze Sp. z o.o. successfully completed flight tests of the M28 aircraft with a composite engine nacelle installed.

The CS2 agreement, financed under the Regional Operational Programme of the Podkarpackie Province and the Clean Sky 2 partnership, created an opportunity for synergy between R&D activities and implementation. This gave companies from the region the opportunity to continue to implement technologies, development of which was initiated in projects financed through the Clean Sky 2 partnership.

In 2017, the Local Government of Region proceeded to create the European Space Agency Business Incubator – ESA BIC Poland in the region, aiming to create and develop companies in the early stages of the space industry development. The activities of ESA BIC Poland will focus on companies that adapt technologies specific to the cosmonautics sector to the needs of other industries, and companies that adapt technologies used in other industries to the needs of cosmonautics, thus creating solutions for commercial use.

Also in 2017, the Podkarpackie Province became a member of the NEREUS association, i.e. Networks of European Regions Using Space Technologies. One of the objectives of the NEREUS network is to ensure that the potential of space services and technologies is utilized by European regions and their inhabitants. Participation in the association enables e.g. the implementation of joint projects in the field of satellite technologies, establishment of partnerships with other members of the network, acquisition of the so-called good practices that can be implemented in the region, and influence over the shape of European space policy. Participation in similar organizations is all the more important because it increases awareness in the range of possibilities of application of many solutions designed for the space industry in other areas of economic and social life.

Active participation in international consortia preparing and implementing large research projects is an important factor in the development of not only enterprises, but also universities. As a part of the Horizon 2020 programme, consortia, including universities from the Porkarpackie Province, carried out a total of 8 research projects. It should be noted, however, that in addition to a relatively small number of projects, only two universities from the province were involved in their implementation: the Rzeszów University of Technology and the University of Information Technology and Manage-

ment (UITM). The University of Technology participated in the implementation of four projects with a total value of EUR 821.7 thousand. All these projects concerned the area related to aviation. UITM participated in a smaller-scale projects, with a total value of EUR 82.3 thousand. Their research topics concerned supporting innovation in the SME sector[51].

In addition, the University of Technology together with local companies EUROTECH and Asseco Poland S.A. participates in an international consortium of sixteen partners implementing the Enhanced RPAS Automation project (ERA) coordinated by Airbus Defence and Space. At the request of the European Defence Agency, as part of the ERA project, Rzeszów University of Technology also integrated automatic take-off and landing systems (ATOL) and AUTOTAXI automatic taxiing system for the unmanned MALE aircraft.

The increase of the degree of internationalization of enterprises and universities can be an opportunity to similarly increase the level of their competitiveness and innovation, which is why it is important to design appropriate support instruments that will encourage these entities to implement projects on an international scale.

3.1.7 Impact of the COVID-19 pandemic on economic development

The COVID-19 pandemic announced in 2020 had a significant impact on the slowdown of development processes in the economy, both at the national and regional level, as well as on a global scale. The pandemic has triggered a global economic crisis, exacerbated by the need to maintain sanitary restrictions and freeze certain sectors of the economy. Around the world, it resulted in such phenomena as: collapse in demand (resulting from reduced mobility), disruptions in supply chains, operational downtime (resulting from the suspension of operations or lack of staff), unfavorable price trends (caused by a decrease in demand) and a deterioration in the financial situation of companies.

The impact of the pandemic on individual industries was diverse, what has resulted from the introduced restrictions and the possibility of switching a given activity to the remote work mode. The industries most affected by the pandemic were: the aviation industry, goods transport, fashion, automotive, tourism, furniture and wood procesing, petrochemical, leisure services, services for companies, and machinery and equipment. These industries accounted for 25% of Poland's GDP and employ around 3.6 million workers[52].

The COVID-19 pandemic has undoubtedly also affected the socio-economic situation of the Podkarpackie Region. Although it did not have a significant impact on the rise of the unemployment rate in the region[53], it forced changes in the organization of work through the use of production downtime or a reduction of working hours. The economic downtime in many industries in the Podkarpackie Province was caused by the collapse of the market (lack of invoices) and the need to comply with

51 Ibidem, p. 101.

52 *Gospodarka w czasach pandemii*, Bank Pekao, 2020, p. 5.

53 According to a study by the Voivodship Labor Office in Rzeszów, almost 57% of Podkarpackie employers declared no reduction in employment since the pandemic occurred, comp. *Podkarpaccy pracodawcy – o wpływie pandemii COVID-19 na zmiany w funkcjonowaniu firm*, Voivodship Labor Office in Rzeszów, Rzeszów 2020, p. 10.

epidemiological recommendations. It was accompanied by a salary reduction for a large part of the employees. The largest group of employees whose salary was reduced (almost 32%), was affected by a reduction of 11-20%. It should be noted, however, that as many as 15.4% of employees received salaries reduced by almost a half[54]. Entrepreneurs' fear for the future of their companies was also manifested in the inhibition or suspension of the implementation of existing development plans. As many as 68.6% of representatives of industries not belonging to regional specialisations and 73% of SS entrepreneurs did not plan to increase employment in the near future. At the same time, 56% and 71.8% of enterprises, respectively, declared that they assess the economic condition of the company as stable. Among the most common reasons behind the deteriorating financial situation, entrepreneurs pointed to the limitation of the number of invoices, reduction of the number of clients resulting from legal restrictions and restrictions prohibiting a specific type of activity, or limiting the number of clients due to the fear of the COVID-19 spread[55].

The occurrence of the pandemic has also accelerated the increase in the use of information and communication technologies capabilities, both for the implementation of teleworking, as well as for maintaining remote contacts with customers. The prolonged effects of the epidemic and related restrictions may have affected the intensification of competition in some industries, which in turn might have cause some of the entities to withdraw from the market. On the other hand, the crisis situation forced companies to put more emphasis on modernizing production, thanks to which it was possible to reduce costs, increase efficiency, and gain competitive advantages[56].

The global pandemic affected the functioning of individual sectors of the economy to varying degrees, including industries belonging to the smart specialisations of the Podkarpackie Province. Market changes have had a very strong impact primarily on the aviation industry, which was an important pillar of the economic development of Podkarpackie Region. They also affected tourism, automotive sector, and the facilities providing medical and health improvement services.

The epidemiological situation around the world has forced the aviation industry to take unusual, non-standard measures in comparison with previous years. Sudden slowdown, or even complete stoppage of the passenger flights in some cases resulted in total or partial closure of the airports, reduced demand for delivery of the flight fuel in the aviation and automotive sector. International Civil Aviation Organization (ICAO) indicated that in March 2020 the number of the available plane seats was reduced by 38% and the number of passengers dropped by 54%. Between January and July about 7.5 million of flights were cancelled worldwide. The loss of revenue recorded by airlines in 2020 was estimated to roughly USD 84 bn, while the lost income might have even reached USD 419 bn. According to optimistic scenarios, the demand for the flights may return to the 2019 levels as soon as in 2023[57].

54 Ibidem, p. 7.

55 *Zapotrzebowanie na zawody*…, op. cit., pp. 3, 17-18.

56 *Gospodarka województwa podkarpackiego*…, op. cit., p. 210.

57 https://www.iata.org/en/iata-repository/publications/economic-reports/Five-years-to-return-to-the-pre-pandemic-level-of-passenger-demand/ [access 31.03.2021].

Grounding majority of the flying passenger fleet resulted in reduced demand for the production of new machines, parts, services and ground service. Companies that have so far produced components for aircraft engines have recorded a regression in sales. More than a third of the entities belonging to the 'Aviation Valley Association' cluster shows that these companies expected a decrease in orders by about 40% compared to the planned ones and a reduction in employment by 2-3 thousand employees. The occurrence of the pandemics may have caused significant changes in the aviation industry, such as: consolidation and limitation of structural problem of the oversupply of the transport capacity, growth of the role of the states in the industry (many lines will require governmental subsidies) and change among the carriers (prolonged crisis may force part of the carriers to withdraw from the market)[58]. Without restitution of the air traffic, recuperation of the the tourism industry may also be difficult.

The COVID-19 pandemic has led to an increase in risk in the automotive sector. There was a drop in demand for cars and gaps in chain supply. As a result of the freezing of the economies of many countries in the period of March-May 2020, the European automotive market shrank by 41.5%. This was also the highest decline in the history of this industry[59].

The impact of the pandemic on this sector was not limited to the reduction of the number of the vehicles produced. As in other industries, pandemic accelerated changes in the mobility model. Recently one could have observed certain reversal of the public transport usage trends, as well as the reduction of growth in the service segment that involves car sharing[60].

In the European Union less than 10 mln of passenger cars were registered in 2020, a decrease by almost 24% in comparison with the preceding year. A similar decrease was recorded in Poland (23%). The lower number of registrations was also visible in other vehicle groups. Vehicle production in Poland decreased by 35%. It was also one of the highest declines among the European Union member states[61]. With the decrease in demand for vehicles, the value of sold production in the automotive industry also decreased. In 2020, it reached the amount of PLN 143.2 billion, which was a result 10.9% lower than in 2019. The value of exports in the same period decreased by 20.4%. The economic downtime of the automotive industry resulted in a reduction of the number of passenger cars produced by 30.5%[62]. The epidemic has also had a significant impact on employment levels. The industry anticipated further layoffs that can be spread over several years, and investments were expected to be reduced (including R&D expenditure).

Tourism, an important part of the smart specialisation Quality of Life, was characterized by a significant susceptibility to adverse environmental phenomena, as evidenced by the collapse of the industry as a result of the global pandemic. It was estimated that in 2020 world tourism traffic decreased by 20-30%, while up to 75 million jobs in this sector were at risk. The pandemic situation was causing

58 *Gospodarka w czasach pandemii…*, op. cit., p. 8.
59 *Branża motoryzacyjna. Raport. Automotive Industry Report 2020/2021*, PZPM, p. 6.
60 Ibidem, p. 19.
61 *Branża motoryzacyjna. Raport kwartalny PZPM i KPMG. Edycja Q1/2021*, pp. 15-20.
62 Ibidem, pp. 78-81.

structural changes in the industry. Tourist destinations were altered and tourism policy was revised by increasing interest in local tourist attractions, in part due due to impoverishment of consumers.

In the country, after lifting restrictions in the summer season, tourist facilities relatively quickly recovered customers, recording a seat occupancy of about 90%. The introduction of the tourist voucher[63] had a great impact on this state. The situation was much worse in places focused on the business clients, where only 25-30% of the seats were occupied.

According to the data of the Statistics Rzeszów[64], the number of people using tourist accommodation facilities in the Podkarpackie Province in 2020 decreased significantly. Said accommodations were used by 710.3 thousand people, including 44.8 thousand coming from abroad. This meant a decrease in the number of domestic tourists using local accommodation facilities by as much as 45.2%, compared to 2019. In the case of people visiting the region from abroad, this is a figure of 3.5-times lower than in the previous year[65]. However, it should be noted that these are definitely better results than the ones for the entire country[66].

Very large losses were incurred by entities providing services in the field of gastronomy. According to Statistics Poland in 2018, there were 69.7 thousand gastronomic facilities in the entire country and revenues in the industry amounted to about PLN 43 billion. The closure of stationary catering outlets resulted in a decrease in turnover by 80-90%. Only food delivery service providers were able to operate and benefited from around 25% increase in orders. At the end of May 2020, restaurants recorded a turnover of about 30% lower compared to the period before the pandemic[67]. As a result of the first lockdown, 48% gastronomic outlets were closed temporarily or permanently. The second stage of restrictions resulted in the cessation of operations by further 25% of premise[68]. The problem catering companies had to face is a change in shopping habits, including catering services. According to research conducted among Polish entrepreneurs operating in the accommodation and catering industry, they were significantly affected by the effects the pandemic had on their businesses and defined them as threatening the stability of the company[69].

ICT was the only industry among the smart specialisations of the region that not only did not experience major losses, but sometimes was able to continue its development because of the pandemic. The popularization of remote work, as well as the implementation of remote forms of contact with customers and supplier have increased the demand for telecommunications services, including both voice and data transmission. The introduction of epidemiological restrictions has influenced the development of the e-commerce sector. With the launch of remote learning, the demand for computer and mobile equipment has increased. The closure of stationary catering establishments has also

63 The tourist voucher is a government form of support for Polish families, aimed at reducing the socio-economic impact of the COVID-19 pandemic. Using a tourist voucher, it is possible to make payments for hotel services or tourist events carried outin Poland, comp. https://www.gov.pl/web/rozwoj-praca-technologia/bonturystyczny

64 *Turystyka w województwie podkarpackim w 2020 r. Informacje sygnalne*, Statistics Rzeszów, Rzeszów 2021.

65 Ibidem.

66 Comp. *Wykorzystanie turystycznych obiektów noclegowych w 2020 roku, Informacje sygnalne*, Statistics Rzeszów, Rzeszów 2020.

67 https://www.rp.pl/Biznes/306079946-Restauracje-po-otwarciu-dalej-mocno-pod-kreska.html [access 31.03.2021].

68 https://hurtidetal.pl/article/art_id,31650-101/pandemia-rujnuje-branze-gastronomiczna/ [access 31.03.2021].

69 *Wpływ pandemii COVID-19 na koniunkturę gospodarczą – oceny i oczekiwania*, Statistics Poland, p. 26.

caused an increase in the popularity of mobile applications for ordering food with delivery. Due to the need for rapid application of many digital solutions, the need to develop and implement technologies that increase the level of cybersecurity was also growing, especially in the rapidly developing e-government sector[70]. These conditions were causing demand for IT services on an unprecedented scale. At the same time, it was a great opportunity for the companies from the Podkarpackie Province representing the ICT industry to significantly accelerate their development.

The influence of the COVID-19 pandemic on most sectors of the economy has caused changes, the effects of which may still be felt for many years after the full removal of restrictions. This called for the development of actions aimed at reduction or elimination of negative effects of the epidemic. It was also necessary to prepare tailored support instruments for those sectors of the economy that have been most impacted by its effects.

The economic crisis created by the pandemic has shown that companies must be open and responsive to changes in the market situation. The ability of companies to adapt to changing conditions was also a factor strengthening their competitiveness on the market, while at the same time enabling the company to build resilience to the effects of potential market collapses in the future.

One of the ways to build such resilience was to diversify the activities of business entities by an introduction of new products or services that differ from the core business. This was an important development strategy, especially for the companies that manufacture components and parts for the specific industries (e.g. aviation). Production limited to a single industry makes the production process dependent on the economic situation of said industry and can often lead to the suspension or sometimes closure of companies' activities in the event of production stagnation. The introduction of a diversification strategy allowed enterprises to open up to other industries and flexibly respond to changing market conditions, reducing production interruptions and thus increasing the company's resilience to the effects of potential future crises[71].

3.2 Innovative potential of Podkarpackie Province

3.2.1 Innovation and R&D

The innovativeness of the Polish economy is not high when compared with other European Union member states. In the *European Innovation Scoreboard 2020* report, Poland is classified as a 'moderate innovator' and the only countries that are ranked lower are Romania, Bulgaria and Croatia.

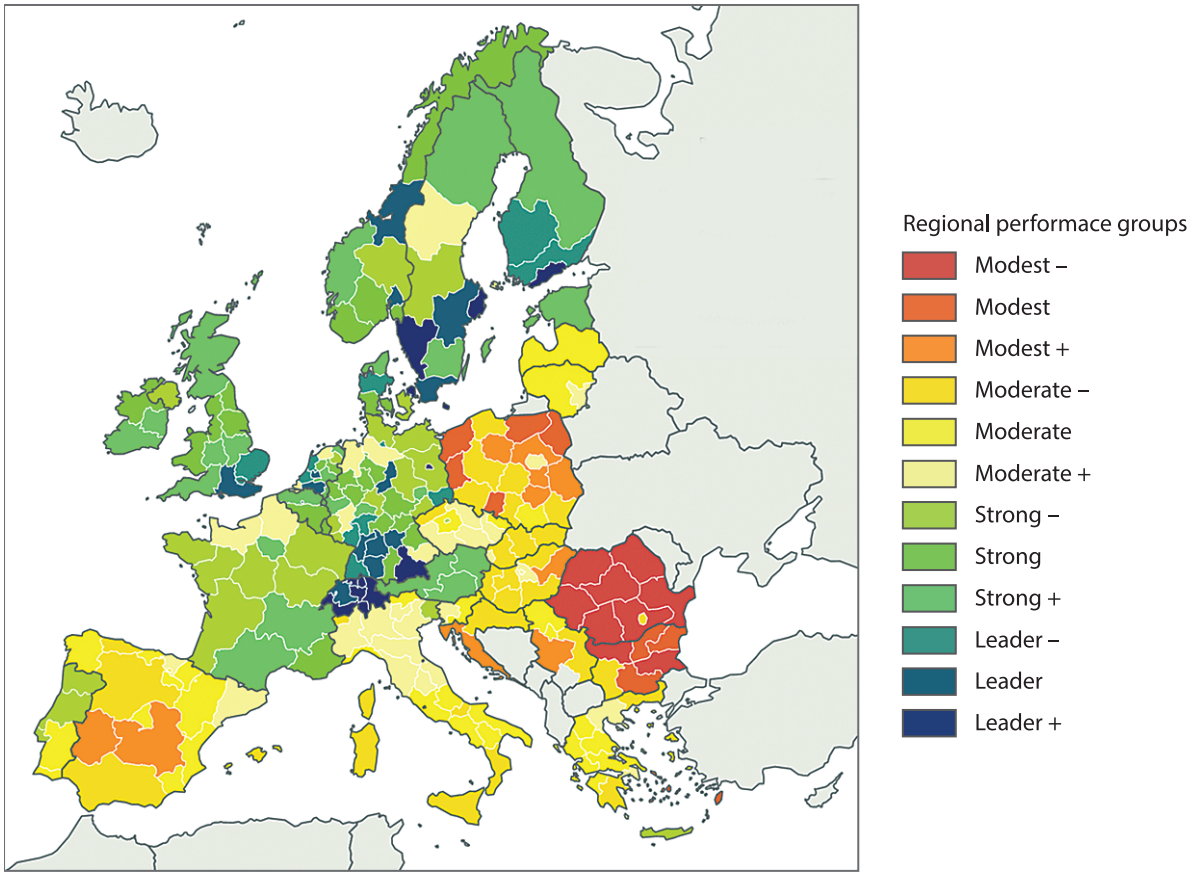
In the *Regional Innovation Scoreboard 2019* report The Podkarpackie Province was ranked 179th among 238 assessed regions of the European Union, with a value of 58.3. Among the Polish regions, the Podkarpackie Province was among the group of 'moderate innovators –', along with the following provinces: Silesia, Wielkopolska, Lower Silesia, Pomerania and Łódź. In addition to the

70 *Inteligentna specjalizacja*…, op. cit., pp. 38-39.

71 Prystrom J., *Innowacyjność i dywersyfikacja działalności gospodarczej jako panaceum na wyzwania współczesnego rynku – wprowadzenie do atlasu dobrych praktyk*, Białystok 2017, pp. 25-26.

Małopolska Province, it is also the Polish region experiencing the highest growth of innovation in the country.

Figure 8. Diversification of innovation in the regions of the European Union



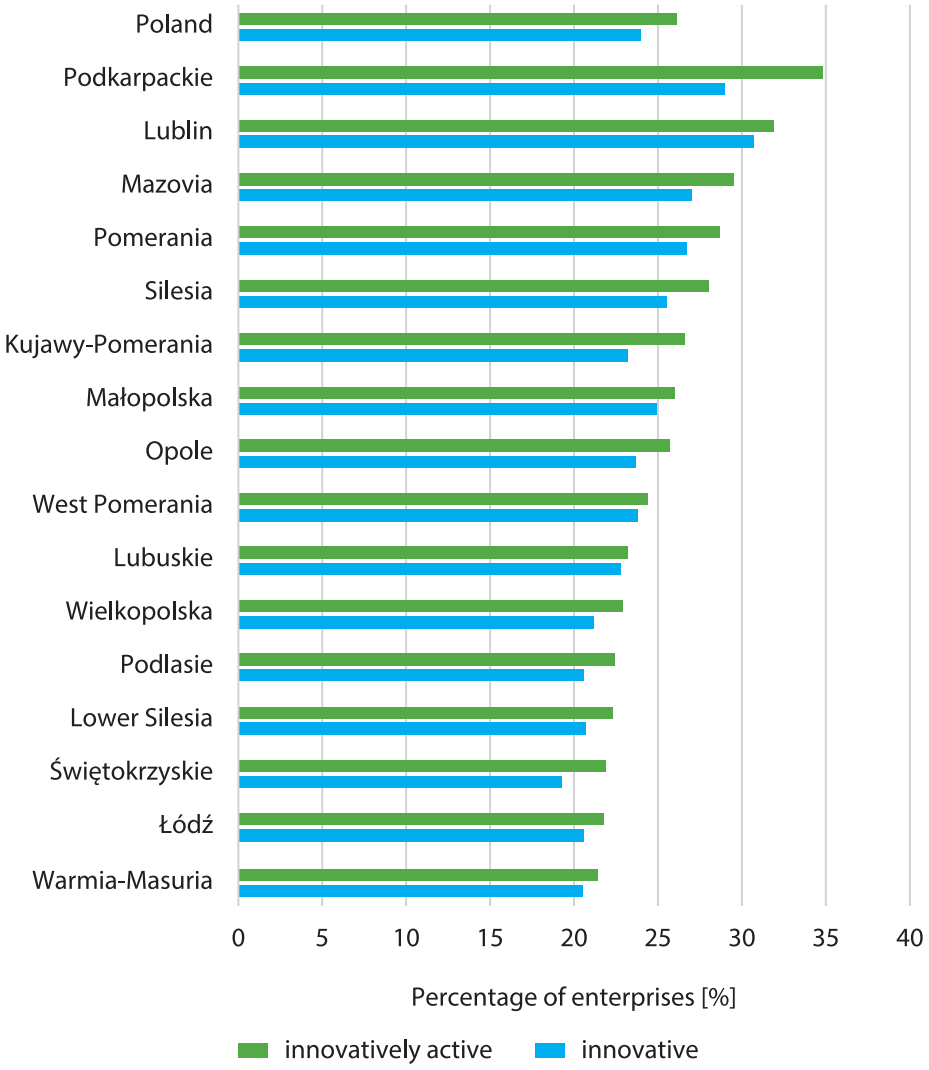
Source: *Regional Innovation Scoreboard 2019*

On a national scale, the Podkarpackie Province occupied the 3rd place, surpassed only by Warsaw Capital Region and Małopolska Province[72]. It is thus the highest rated region among the Polish East provinces. It is worth noting, however, that Podkarpackie Region in each of the subsequent reports was ranked higher, which indicates an increase in its innovation when compared to EU regions.

In the years 2016-2018, the Podkarpackie Province was listed among the most innovative ones when it comes to the activity of industrial enterprises. It recorded the highest percentage of innovatively active enterprises (i.e. those that implemented at least one product or process innovation or conducted discontinued or incomplete innovative activities) and a high share of innovative enterprises (i.e. those that introduced at least one product or process innovation during the period under review, which was new at least to the examined company), which allowed the region to take the second position in the country after Lublin Province.

[72] Bożek E., Inglot W., Koprowicz D., Kowalik M, Szczęch P., Ziomek-Niedzielska B., *Wiodące branże województwa podkarpackiego – inteligentne specjalizacje regionalne*, Rzeszów 2020, p. 4.

Figure 9. Innovatively active industrial enterprises in years 2016-2018



Source: own study

In industrial enterprises from the Podkarpackie Province, there was also the highest percentage of entities spending on the R&D activities. They also took the first place in the country in terms of the percentage of enterprises that financed this activity from their own resources.

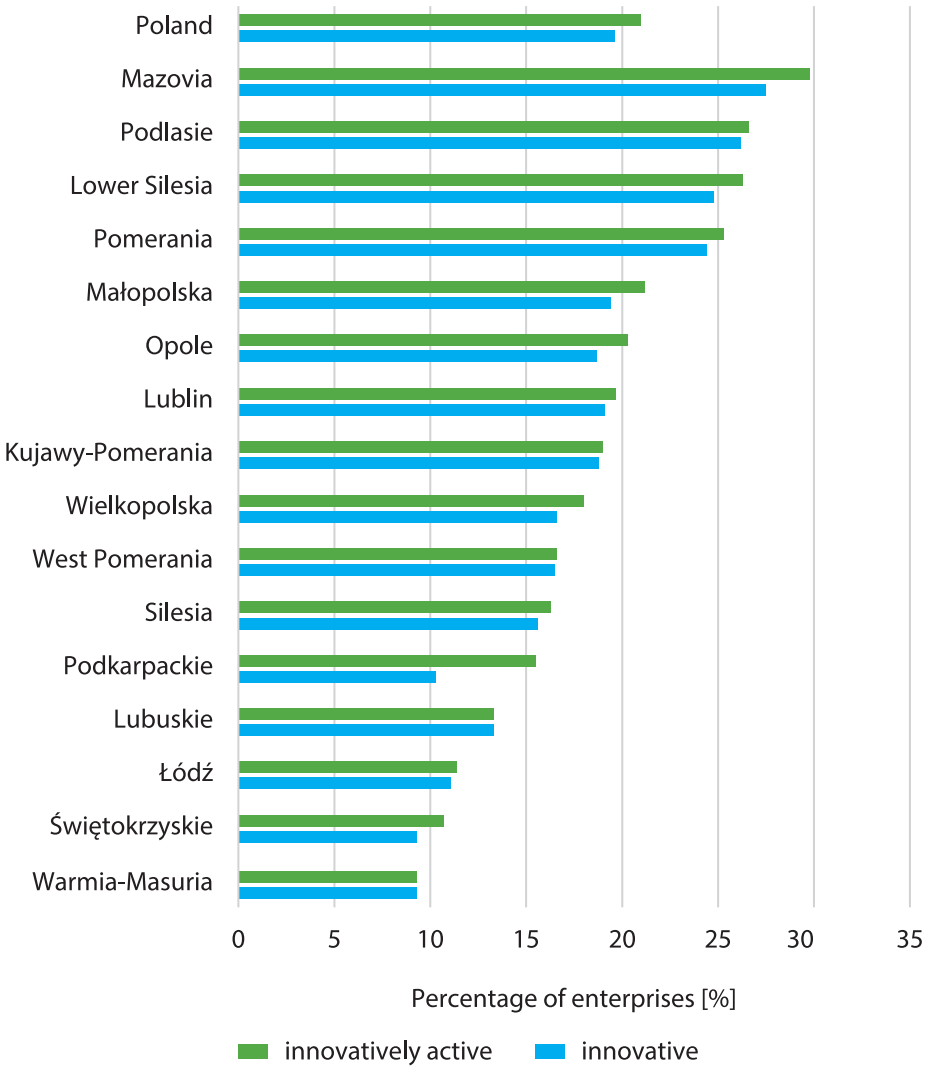
Important part of the assessment of the innovative activity of enterprises in the region is the number of entities in which R&D activity occurred in a given year. The analysis of the period 2009-2018 indicates that Podkarpackie Province was one of the most active regions in Poland, ranking 3rd after the Kujawy-Pomerania and Opolskie Provinces in terms of the dynamics of growth in the number of entities that conducted such activities per 100,000 entities of the national economy. In all these provinces, this metric increased more than fourfold and significantly exceeded the dynamics of this phenomenon in the country.

Product innovations were most often recorded in the industrial enterprises most often in Lublin (22.2% of enterprises) and Podkarpackie (21.5%) Provinces. The highest percentage of the surveyed

entities that introduced innovations in business processes in this period was observed in Lublin (24.5% of enterprises) and Podkarpackie (24.3%) provinces[73].

Service companies from the Podkarpackie Province in the years 2016-2018 were less innovative compared to Polish regions. Only 15.5% were active, and innovations were implemented by 10.3% of the surveyed entities.

Figure 10. Innovatively active service enterprises in years 2016-2018



Source: own study

However, a positive trend of growth of spending on innovative activities can be observed in the service enterprises. In the years 2014-2019, its value increased by 76%. In 2019, it reached PLN 764.6 million, what allowed them to be ranked 6th in the country.

[73] *Działalność innowacyjna przedsiębiorstw w latach 2016–2018*, Statistics Poland, Statistics Szczecin, Warsaw–Szczecin 2019.

The service enterprises from the Podkarpackie Province were rarely spending on R&D activities (9th place in the country). They also ranked 11th in the country in terms of the percentage of companies that financed these activities from their own resources[74].

Product innovations were recorded in 6.9% of service enterprises in the region (9th place in the country). The leader in this respect was the Lower Silesia Province (15.4%). Business process innovations in the years 2016-2018 were introduced in the Podkarpackie Province in 7.8% of the surveyed enterprises (16th place in the country). The best result in this case was recorded in the Mazovia Province (25.3%)[75].

An factor centrainly influencing the level of innovation of the region is the developed structure of the regional innovation system, including the presence of business environment institutions (BEIs), providing a wide range of services primarily to enterprises. They are meant to strengthen the competitiveness and innovative activity of companies. In Podkarpackie Province in 2020, 51 BEIs were identified, including e.g. 15 entrepreneurship centres and 21 innovation centres[76]. It should also be noted that the saturation of the region with these entities measured by the number of BEIs per 10,000 entities of the national economy has been the lowest in the country for several years (in 2019, the value of the indicator was 517.5 with the average for the country being equal to 864.0). In addition, it should be noted that most of these institutions primarily provide only basic services to enterprises. Specialist, pro-innovation services are offered by only half of them[77]. Therefore, this is an area that requires additional support that will allow the expansion of the offer and increase of their professionalization. It is also necessary to specialize regional BEIs in relation to the scope of services provided, as well as to ensure the supply of all services sought by entrepreneurs from the Podkarpackie Province.

The presence of business incubators and accelerators in the province is conducive to the emergence of start-ups and academic spin-offs and spin-outs. In 2017, the number of enterprises of this type was estimated at approx. 200 (start-ups) and 60 (spin-off and spin-out companies, of which approx. 50 benefits from the support of Academic Business Incubators)[78]. The development of this type of innovative enterprises (including primarily spin-offs and spin-outs, enabling the commercialization of research results developed by universities) is of great importance for the development of the region. As part of the Start in Podkarpackie project implemented by RRDA, the incubation programme included 176 companies, of which 104 entities completed the incubation process by the end of 2020. It should be noted, however, that as much as 1500 applications were received, what proves the scale of the demand for support for this type of enterprises. Therefore, it will be necessary to take further actions to enable the development of this type of enterprises in the Podkarpackie Province.

One of the indicators proving the innovation potential of Podkarpackie enterprises may be the number of projects in the field of creation or development of the research and development infra-

74 *Działalność innowacyjna przedsiębiorstw*…, op. cit.
75 Ibidem.
76 *System innowacji*…, op. cit., p. 47.
77 *Potencjał i działalność Instytucji Otoczenia Biznesu*…, op. cit., p. 87.
78 *Przedsiębiorczość w województwie*…, op. cit., p. 213.

structure, selected for co-financing under Axis I of the ROP PP 2014-2020. The total number of projects selected for funding was 24, out of which 18 are eventually being implemented.

Table 4. Number of projects concerning the creation or development of R&D infrastructure in enterprises selected for co-financing in Axis I of the ROP of the Podkarpackie Province 2014-2020

Type of business activity	Applicant/ beneficiary indus-try as per PCA section (ap-plies to the applicant's main activity)	Number of projects selected for funding	Number of implemented projects (as of 20.04.2021)	Smart specialisation in which the project fits in
	J.6 – Activity related to soft-ware, IT sup-port and related activity	1	0	Information and Te-lecommunications
Management consul--tancy activities	M.70 – Management consul-tancy	2	2	Aviation and Co-smonautics, Infor-mation and Tele-communications
Scientific research and development tests	M.72 – Scientific research and deve-lopment	1	1	Information and Te-lecommunications
Healthcare, inclu-ding diagnostics and ther-apy of the diseases of civiliza-tion, and healthcare in personalized medicine	Q.86 – Healthcare and social assistance	1	1	Quality of Life
Industrial produc-tion, including modern technolo-gies for obtaining, processing and using natural resources, and pro-ducing their substi-tutes	C.16 – Manufacture of products from wood and cork	1	1	Quality of Life
	C.22 – Manufacture of products from rubber and plastics	3	3	Automotive, Quality of Life
	C.23 – Manufacture of other non-metal-lic mineral products	2	2	Quality of Life
	C.25 – Manufacture of fabricated metal-products, ex-cluding machinery and equipment	7	4	Aviation and Cosmonautics, Automotive, Quality of Life, Information and Telecommuni-cations

Type of business activity	Applicant/ beneficiary indus-try as per PCA section (ap-plies to the applicant's main activity)	Number of projects selected for funding	Number of implemented projects (as of 20.04.2021)	Smart specialisation in which the project fits in
	C.26 – Manufacture of com-puter, elec-tronic and optical products	1	1	Aviation and Co-smonautics, Infor-mation and Tele-communications
	C.28 – Manufacture of ma-chinery and equipment not clas-sified elsewhere	1	1	Aviation and Co-smonautics, Quality of Life, Information and Telecommuni-cations
	C.30 – Manufacture of other transport equipment	1	1	Aviation and Co-smonautics
Commerce	G.46 – Wholesale tra-de, except of motor vehicles	1	0	Quality of Life, Infor-mation and Tele-communications
Automotive industry, including environ-mentally friendly transport solutions	C.29 – Manufacture of mo-tor vehicles and trailers, exclu-ding motorcycles	1	1	Automotive, Quality of Life
Chemical, including biotechnological processes and spe-cialised chemical chemistry and environmental engineering	C.20 – Manufacture of chemicals and chemical products	1	0	Quality of Life

Source: own study

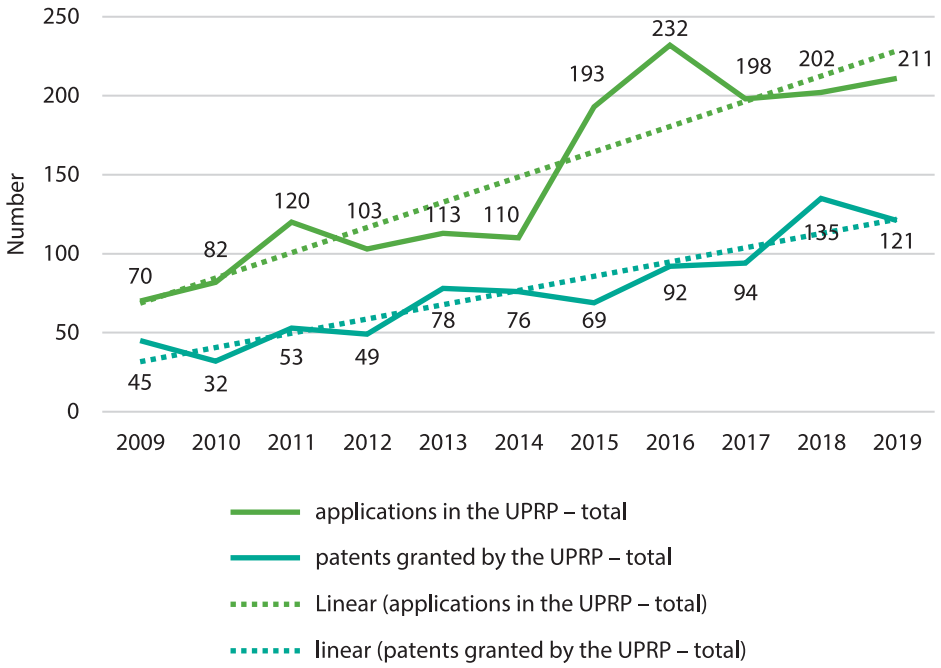
All projects selected for funding are part of the regional smart specialisations of the region. The largest number of projects were related to the Quality of Life specialisation (13 in total). It should be noted, however, that applicants have often indicated more than one specialisation in which the project would fit in.

The factor that differentiates the innovativeness of business entities may be the size of the enterprise measured by the number of employees employed. Data from the Statistics Poland clearly indicate that among the surveyed Podkarpackie enterprises, large companies are characterized by the highest innovation. As the size of enterprises decreases, the percentage of those that declare implementation of any innovations decreases accordingly. This may mean the need to support smaller entities both in terms of financing and raising funds or even brokerage services including pro-innovation services and cooperation in the development and implementation of innovations, because small entities may not be able to independently implement advanced innovation projects.

3.2.2 Protection of industrial property

In the Podkarpackie Province, much like in the country, the number of applications to the Patent Office of the Republic of Poland increases. There has been a steady increase in the number of patents granted in the Podkarpackie Province since 2009, but it is slower than in the case of the number of applications to the Polish Patent Office made by entities from the region. Despite the slower growth, there was a nearly threefold increase in the number of patents granted in this period.

Figure 11. Patents granted by UPRP in total in Poland and Podkarpackie Region

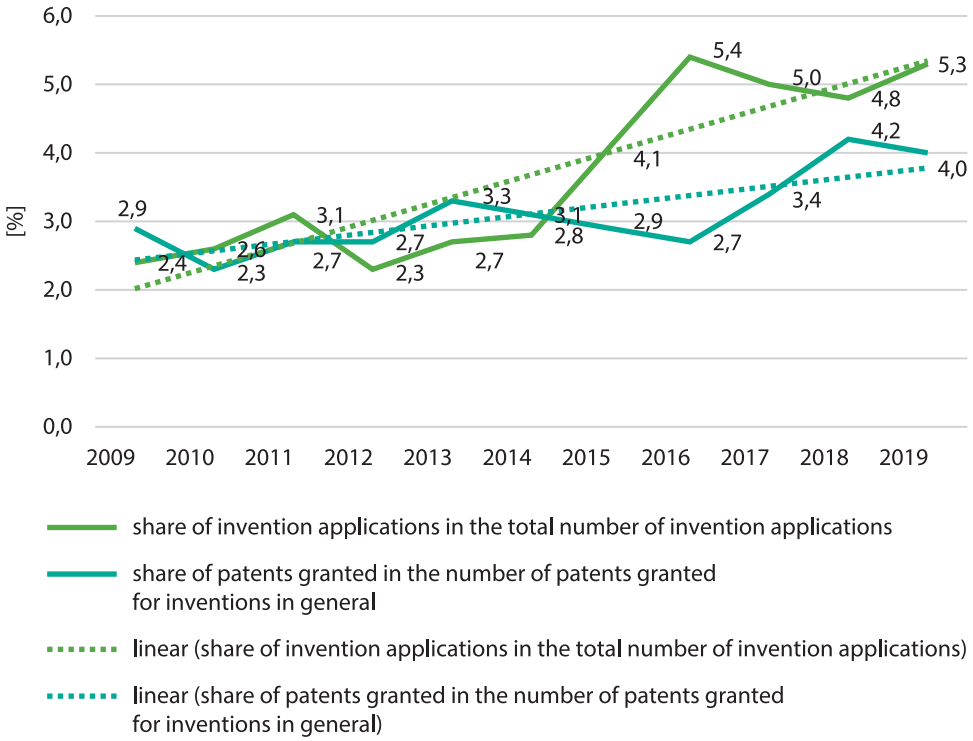


Source: own study

The Podkarpackie Province is also characterized by a constant increase in the share of applications of inventions in total in Poland (in 2019 it amounted to 5.3%, which is an increase of 2.9 percentage points compared with 2009). The increase in the share of invention patent applications from the Podkarpackie Province in the number of total invention patent applications is a positive and desirable trend, but the increase in the percentage of patents granted is slower (an increase of 1.1% compared to 2009). A lower success rate in this case may be worrying and it may be advisable to support the reporting entities at the stage of the solution development and report preparation.

Analysis of changes in the number of invention applications per 1 million inhabitants in Podkarpackie Province indicates a much faster growth when compated to national average, which means high activity of entities from the region in the field of innovation. It is important that in the years 2009-2019 the province achieved a threefold increase in the index (99.2% in 2019 compared to 33.2% in 2009), what puts the region in the first place in Poland. While maintaining the growth rate of the number of invention applications per 1 million inhabitants, the Podkarpackie Province may achieve higher rates than the national average in a short time.

Figure 12. Ratio of number of application for the inventions in Poland and the Podkarpackie Province and share of patents granted in the number of the patents granted in total for the years 2009-2019 [%]



Source: own study

The greatest activity in the field of patenting in 2019 was shown by entities located in Rzeszów. Almost all (except one) applications made by research institutes and universities, and all patents granted to these entities came from the capital of the province. Applications made by business entities most often came from the Rzeszów district and city of Rzeszów. The majority of applications made by natural persons came from this area. Companies from the Mielec district also showed great activity.

In the case of patents granted per 1 million inhabitants, the Podkarpackie Province recorded an increase, but the trend is similar to the country average trend. This means that the province does not eliminate the distance that separates it from the leaders. A larger number of patents obtained creates opportunities to obtain revenues from the commercialization of scientific results and improve the competitive position thanks to legal protection applied by enterprise solutions. This is an important element of discouraging the imitation of their business activity[79].

[79] *Market success for inventions Patent commercialisation scoreboard: European SMEs*, European Patent Office, Munich 2019.

The highest activity in the field of intellectual property protection in the Podkarpackie Province in 2019 was demonstrated by the Rzeszów University of Technology which obtained 36 patents (12th place in the country) and 5 rights for the protection of utility models (9th place)[80]. Data from the Patent Office of the Republic of Poland indicate that in 2019 application were most often related to civil engineering, chemistry of high-quality organic compounds, specialized machines, measurements and transport. The fewest notifications were submitted for IT management methods, basic communication processes, digital communication, telecommunications, microstructural technologies and nanotechnologies[81].

The Podkarpackie Province and Lubelskie Province were assessed by the experts of Bank Millenium S.A. as regions that have a higher innovation potential than the strength of its economy measured by the share of GDP generated. Said expets also draw attention to the fact that in these provinces the percentage of companies that cooperate for innovation is the largest. They believe that greater trust can unleash the potential to deliver measurable results without having to incur large financial outlays[82].

3.2.3 Cluster activity

One of the forms of cooperation undertaken by enterprises in order to increase their productivity and competitiveness through e.g. increase of the level of innovation of companies is the establishment of a cluster initiative. Clusters provide a place for the transfer of knowledge and technology, enable their members to create or integrate into previously created supply chains, and, by participating in the cluster structures of research and scientific units, to conduct joint research work with these units and share their results.

According to Statistics Poland data, the Podkarpackie Province has been a leader among all provinces since 2013, as based on the metric regarding the share of industrial enterprises (employing between 10 and 249 people), cooperating as part of cluster initiatives among all enterprises undertaking innovative activities. In 2019, the value of this metroc amounted to 35.3%, which was the 2nd place in the country, thus exceeding the Polish average by 14.8 percentage points. At the same time, this means an increase of 25.8 percentage points on comparison with 2013.

Number of active clusters operating in the Podkarpackie Province in the years 2012-2017 grew steadily, while in 2018 a decrease in the number of clusters, and thus the number of cluster members, was recorded[83]. In 2020, 22 clusters were active, of which 19 clusters were part of the region's smart specialisations. Most of the functioning clusters have a regional scope, although two clusters (the Association of Aviation Industry Entrepreneurs Aviation Valley Group and the Cooperative Association Of Light and Ultralight Aviation Cluster in Podkarpackie Region) have an international scope.

80 *Raport Roczny 2019*, Patent Office of the Republic of Poland.

81 Ibidem.

82 *Indeks Millennium 2019. Potencjał Innowacyjności Regionów*, Bank Millennium S.A., 2019, p. 5.

83 *Informacja o stopniu realizacji Strategii Rozwoju Województwa – Podkarpackie 2020*, Regional Territorial Observatory of the Marshal Office of the Podkarpackie Province, Rzeszów 2020, p. 109.

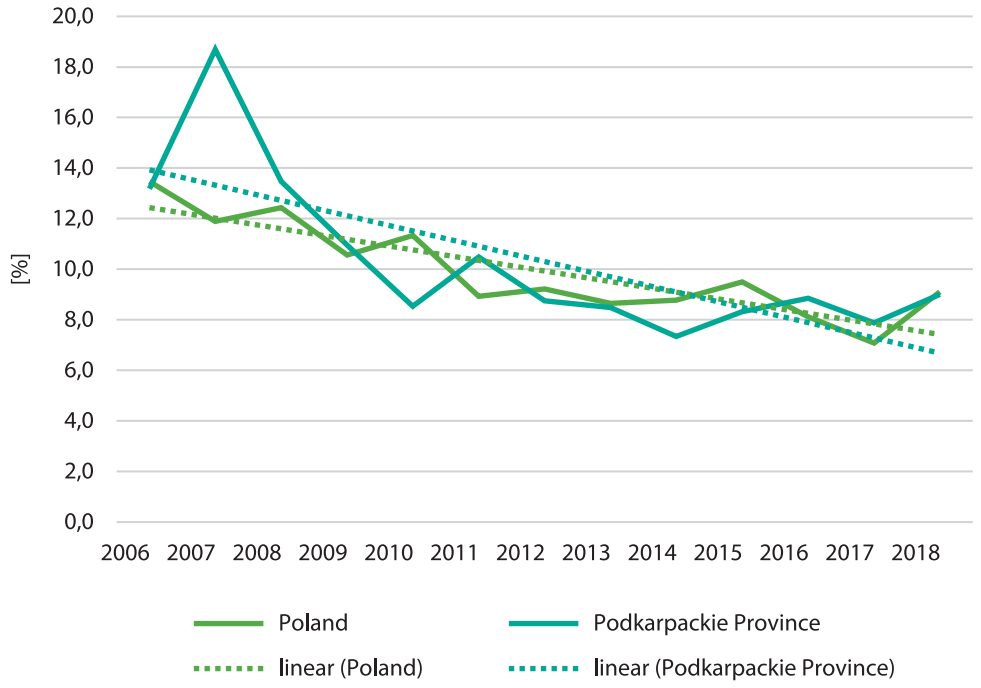
Also two clusters (Aviation Valley and the Polish Automotive Group), operating in the Podkarpackie Region, have the status of a national key cluster, which means that they have been recognized as important for the development of the country's economy[84]. Initiatives are also being taken to establish cosmonautics and hydrogen clusters in the Podkarpackie Province. Their creation can significantly contribute to acceleration of the development of these areas in the region.

It should be noted that the activity of clusters operating in the Podkarpackie Province can be strongly influenced by the possibility of obtaining funding for the cluster's activities. As a result of difficulties in obtaining financial support, some clusters were dissolved or suspended their activities.

3.2.4 Financial results of innovative activities

Since 2007, a worrying decrease in the share of net revenues from the sale of innovative products in total sales revenues has been observed in the Podkarpackie Province. A similar trend, but with a slower pace, occurred throughout the country.

Figure 13. Share of net revenues frotm the sale of innovative products in net revenues from total sales



Source: own study

Share of net revenues from the export of innovative products in the net revenues from total sales since 2008 is stable, with a visible linear upward trend. This phenomenon should be assessed positively, because throughout most of the analyzed period of 2008-2018, the index for the province often reached values higher than the average for the country, which in turn shows a downward trend.

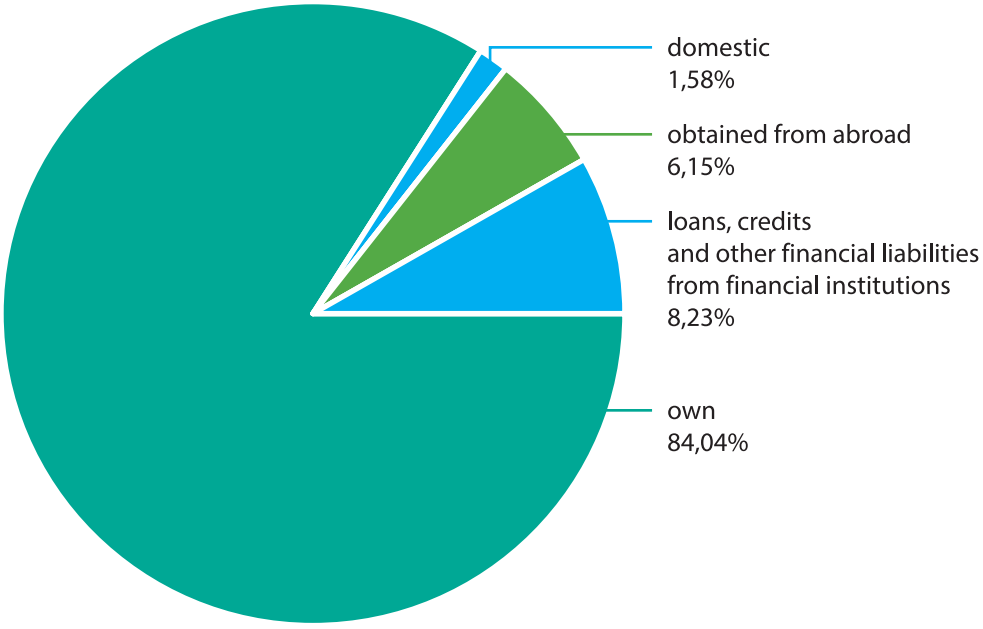
84 *System innowacji*…, op. cit., pp. 29-30.

In the case of the share of net revenues from the sale of innovative products in net revenues from total sales in enterprises from the industrial processing section, similar trends are visible as in the case of all enterprises. It should be noted, however, that these companies have a higher value, what may indicate an increased emphasis on the development of innovative products and an increase in their share of sales. Unfortunately, in the years 2006-2018 this metric shows a downward trend.

3.2.5 Financing of the activities related to innovation and R&D

Expenditures on innovative activities are largely funded from the own funds of enterprises. In 2018, they accounted for 75.5% of all such spending in industrial enterprises across the country. In the case of Podkarpackie Province, the commitment of own funds was higher and amounted to 84.04% of total expenditures.

Figure 14. Source of financing innovative activity of the enterpises in 2018



Source: own study

Spending on innovative activities in enterprises in relation to GDP in the Podkarpackie Provinces does not differ from the average values observed in the country.

Internal expenditures of the enterprise sector on R&D activities in relation to GDP in the Podkarpackie Province remained high. In the years 2010-2015, the Podkarpackie Province was the national leader in this respect. In the next period (2016-2018) it was second only to the Małopolska, Mazovia and Pomerania Provinces.

3.2.6 Implementation of Industry 4.0 and Circular Economy solutions in Podkarpackie Province[85]

Industry 4.0 (also called Economy 4.0) is another economic revolution that has introduced the large-scale implementation and use of new information technologies, mobile technologies, machine learning and artificial intelligence[86]. Due to the versatility of the applications of these technologies, there is currently no industry in which these solutions would not be used. It also forces the introduction of changes in the production process from the 'push' model (i.e. production and 'pushing' the product to the customer) to 'pull' production (where production responds to the needs of the market, without creating unnecessary stock).

In terms of infrastructure, the Podkarpackie Province is relatively well adapted to the implementation and popularization of digitization in both enterprises and households. In 2019, 96.8% of enterprises and 86.8% of residences had broadband Internet access. In both cases, these values were higher than the national average. In this context, the increasing use of the Internet by companies to contact public administrations is also noteworthy. In 2018, the value of this metric amounted to 96.1% of the share of all non-financial sector enterprises in the region.

In the context of digitization, it should also be noted that most local government units (LGUs) as well as universities have implemented various types of Electronic Documentation Management (EDM) systems. Unfortunately, the level of their use is insufficient. Only 5% of the offices in Podkarpackie Provinces use them to carry out all tasks. Most often, only 25% of all cases are handled via these systems. One of the most frequently indicated barriers to the full use of electronic document management is the low level of maturity of services provided by local government units, as well as incomplete internal integration of systems and insufficient level of cooperation between EDM and other domain systems used by the LGUs[87]. There is no doubt that the process of digitization and growing public awareness in this area will soon force an acceleration of the pace of work on the implementation and dissemination of solutions related to EDM in the sector of administration.

Progressive digitization and automation of processes force the introduction of changes also in enterprises in the Podkarpackie Province. Increasingly, there is a need to not only reorganize production, but also to modify the management model of the companies. In order to increase or at least maintain the current level of competitiveness, enterprises in the Podkarpackie Province must not only implement technologies and business solutions already present on the market and do it as soon as possible, but also look for innovative products or technologies. The completed study on the application of Industry 4.0 solutions in the enterprises from Podkarpackie Province showed that the level of their implementation is relatively small[88]. The most common instrument of Industry 4.0 used

85 Prepared on the basis of the results of research commissioned by the Podkarpackie Province: *Gospodarka województwa podkarpackiego wobec wyzwań Przemysłu 4.0*, Rzeszów 2020 and *Gospodarka obiegu zamkniętego w przedsiębiorstwach województwa podkarpackiego*, Wrocław 2021.

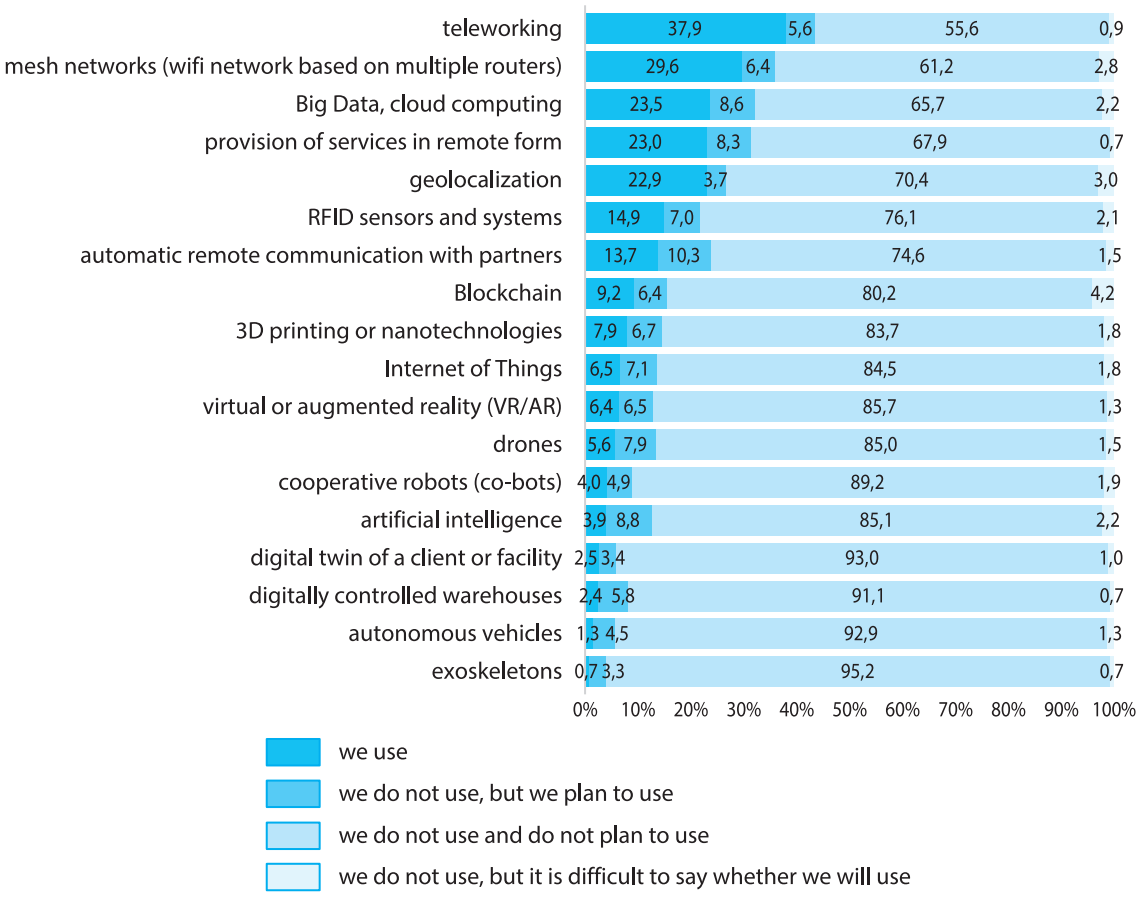
86 *Gospodarka województwa podkarpackiego*…, op. cit., p. 28

87 *Efekty wsparcia zastosowań TIK dla usług publicznych*, LB&E, Ego, Warsaw 2020, p. 106.

88 As part of the survey, surveys were carried out on a sample of 673 Podkarpackie enterprises with layering due to the size of the enterprise, categories of PCA sections and subregions, cf *Gospodarka województwa*…, op. cit., p. 25.

by regional entrepreneurs is remote work, which is used by almost 40% of employers. The COVID-19 pandemic had undoubtedly impacted the acceleration of the implementation of this solution and its dissemination. Quite popular solutions used by the companies in Podkarpackie Province include the use of mesh networks (used by 29.6% of enterprises), Big Data analysis (23.5%), remote provision of services (23%) and geolocation (22.9%).

Figure 15. Application of selected modern solutions/technologies in enterprises operating in the Podkarpackie Province



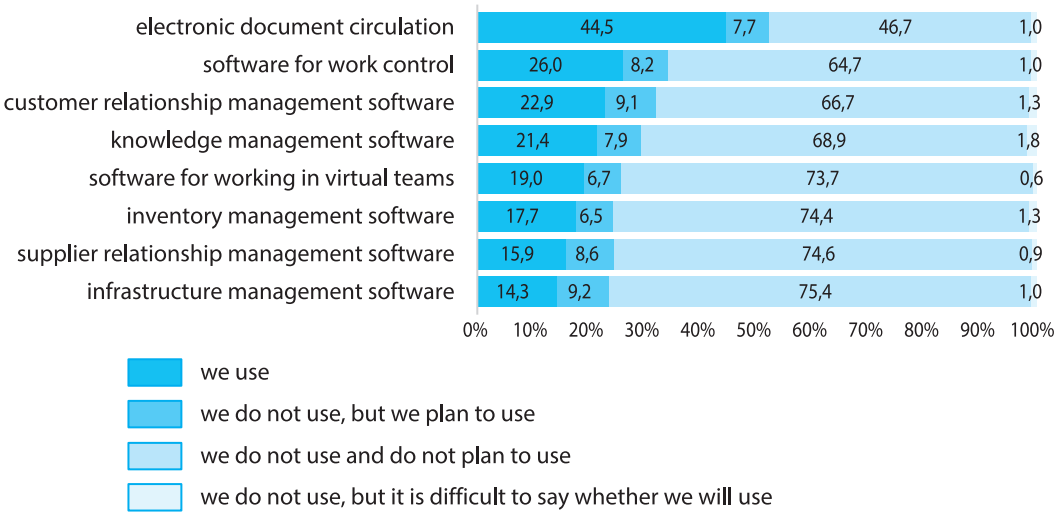
Source: *Economy of the Podkarpackie Province in the face of the challenges of Industry 4.0*, Rzeszów 2020

In industrial enterprises operating in Podkarpackie Region more and more often individualization of production is used, defined as the manufacturing of products for a specific order. Currently, they are used by almost 34% of the surveyed industrial enterprises. The use of automation and robotization is also slowly becoming widespread. Machine controls and devices that include machine learning capabilities are used by 20.5% of enterprises[89].

89 Ibidem, p. 110.

Among information and communication technologies, the most common applications in Podkarpackie companies are systems related to the electronic circulation of documents (used in 44.5% of enterprises). Work control software (used by 26% of survey respondents) and customer relationship management software (23%) are also gaining popularity[90].

Figure 16. Usage of the systems based on information-communication technologies in the enterprises operating in the Podkarpackie Province



Source: *Economy of the Podkarpackie Province in the face of the challenges of Industry 4.0*, Rzeszów 2020

The study found a correlation between the number of modern solutions or technologies and the size of the company. The larger the company, the more technologies/innovative solutions were used. It is not surprising that their popularity in the high-tech industry or services is thrice as high than in the more traditional sectors of the economy such as agriculture or services[91]. The survey also showed that companies from industries identified as regional smart specialisations implemented Industry 4.0 solutions to a greater extent than others. This trend also includes industries that make up the Quality of Life specialisation, despite seeing them as more traditional branches of the economy.

The main barrier to the dissemination of modern solutions is the high cost of their application. They often require companies to incur greater financial outlays at the implementation stage, and important effects of their application, including reimbursement of costs incurred, can sometimes occur only after a longer period of time. Another important factor slowing down the introduction of Industry 4.0 technologies to companies is the insufficient supply of qualified staff. When considering the barriers to the dissemination of new technologies and solutions in the field of Industry 4.0, attention should also be paid to the fact that some enterprises fail to recognize the need to implement them. However, it can be assumed that the lack of use of innovative technologies by entrepreneurs results not so much from the lack of need to implement them, but from the lack of awareness of such a need

90 Ibidem, p. 165.
91 Ibidem, p. 115.

and from a failure to notice how the implementation of new technologies can increase the level of competitiveness of the company[92].

The new industrial revolution affects not only the economic sphere, but also social life. Progressive digitization forces significant modifications both in terms of production processes in enterprises and ways of managing them. It also makes it necessary to introduce significant changes i.a. in the education system, which must be more responsive to the needs of the labour market. This requires the design and implementation of appropriate support instruments and incentive mechanisms that will speed up the implementation of solutions in the field of Industry 4.0, while maintaining or increasing the pace of development of the economic region.

One of the challenges faced by the enterprises from the Podkarpackie Region is the necessity to take into account the processes of production and enterprise management as a separate issue related to the circular economy. The aim of the latter is to extend the life cycle of products and reduce the generation of waste to a minimum. The acceleration of activities aimed at implementing solutions in the field of circular economy is forced by the EU policy imposing on member states the obligation to strive for climate neutrality.

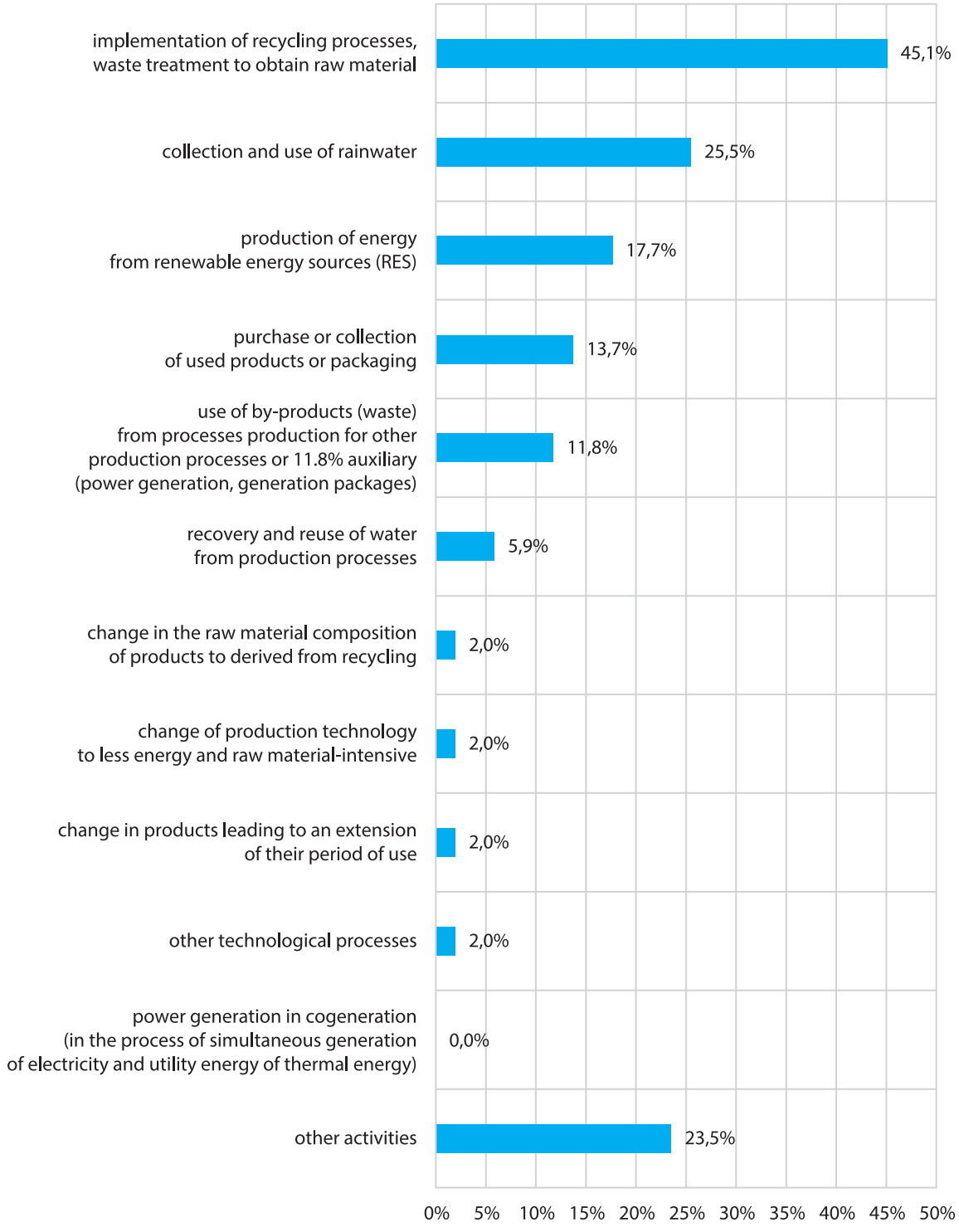
The conducted analyses show that the vast majority of Podkarpackie entrepreneurs (83.4%) do not know the concept of a circular economy, although they they are obliged by law to introduce separate waste collection. Studies do not indicate a significant difference in this respect between industries, or between the enterprises of varied size.

The low level of awareness of the importance of circular economy is accompanied by an even higher percentage of companies that have not yet implemented any solutions in this area. Only 51 companies from Podkarpackie Province out of 541 respondents used any circular economy activities. It is also worrying that over 91% do not see the need to implement such solutions in the coming years. This means that it is necessary to take action to increase awareness in the area of the circular economy by, for example, conducting information campaigns.

Among the enterprises that have implemented the concept of circular economy, the most commonly used are: implementation of recycling processes, waste processing to obtain raw material, collection of and the use of rainwater and the production of energy from reneweable sources. These three solutions are also indicated as the most effective.

[92] Almost 91% of respondents to the survey asked about the reasons for not using modern solutions or technologies indicated that there was no need to implement them, comp. *Gospodarka województwa*…, op. cit., p. 155.

Figure 17. Types of solutions in the scope of circular economy implemented by the Podkarpackie enterprises



Source: *Circular economy in enterprises of the Podkarpackie Province* report, Wroclaw 2021.

It should be noted that entrepreneurs do not see greater efficiency of activities related to the use of recycled materials in manufacturing, what may mean that these materials are not considered a valuable alternative to raw and virgin materials, even though this is one of the main elements of the transformation towards circular economy. However, such a position may be influenced by the fact

that not every raw material can be currently replaced by recycled products. Search for such substitutes will likely be forced in the future due to dwindling supply of many primary raw materials.

The implementation of circular economy solutions has brought results such as reduction of the costs of doing business in as many as 31.4% of entrepreneurs who decided to use them. It is interesting kwestia that almost 12% indicated an increase in the level of innovation of the company after the implementation of circular economy solutions.

Solutions in the field of circular economy sometimes require entrepreneurs to incur sometimes high initial costs, and the effects of their implementation, especially financial ones, are visible only even after a few years. Therefore, it is not surprising that the most frequently indicated barrier to the implementation of the circular economy concept is their excessive cost. This is particularly noticeable in small and medium-sized enterprises – 70.6% and 61.5% of small and medium-sized enterprises, respectively, highlighted the cost as the main barrier. Therefore, in the next financial perspective, financial support for companies will be necessary, which will be an important instrument supporting the achievement of a greater level of application of the circular economy concept in enterprises from the Podkarpackie Region[93].

3.3 The potential of industries representing the smart specialisations of the region[94]

In the *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020* updated in 2016, four smart specialisations of the region were indicated: Aviation and Cosmonautics, Automotive, Quality of Life and Information and Telecommunications. Industries representing the above SS have been identified as having the greatest potential to increase the level of innovation and competitiveness of the province, and thus play an important role in the socio-economic development of Podkarpackie Region.

3.3.1 Aviation and Cosmonautics

The aviation industry was one of the first to develop in the Podkarpackie Province. Traditions related to this branch of the economy, above-average concentration of enterprises, high research and development potential, as well as an active cooperation in clusters and an extensive system of staff education for industry are obvious competitive advantages of Podkarpackie Region, both on a national and European scale. This led to the designation of Aviation and Cosmonautics as the first smart specialisation of the region.

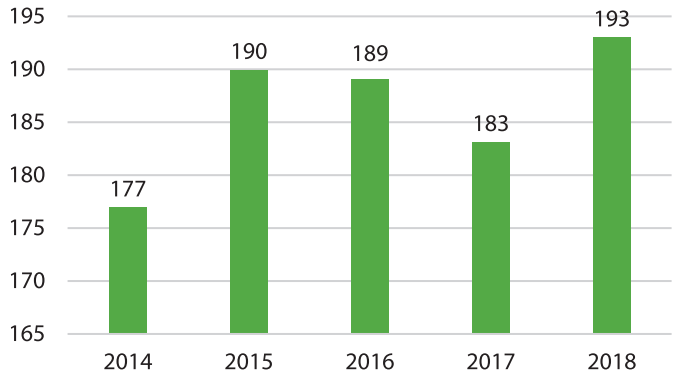
93 Bernatowicz W., Raftowicz M., Ryng-Duczmal W., Raczkowski K., Szkudlarek Ł., Ziętek-Fidecka A., *Gospodarka obiegu zamkniętego w przedsiębiorstwach województwa podkarpackiego*, Wrocław 2021.

94 Applies to industries identified as smart specialisations of the region in the update of the *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020* from 2016 and Action Plans adopted for individual specialisations.

Podkarpackie Province is characterized by an above-average (relative to the country and the European Union) concentration of companies representing the aviation industry and related economy sectors, such as defense, electromechanical production, foundries and manufacturing of composite materials. The possibility of such intensive development and accumulation of aviation-related enterprises in the region were, to a large extent, a result of the intrinsic potential of Podkarpackie Region, including traditions related to the electromechanical industry that have been present in the region since the formation of the Central Industrial District.

Since 2014, an increase in the number of companies can be observed in the Podkarpackie Province classified as Aviation and Cosmonautics SS[95]. In 2018, there were 193 operational entities, which is an increase of 9% compared to 2014. Of this number, 51% were large enterprises employing at least 50 employees.

Figure 18. Number of companies from the aviation and cosmonautics industry registered in the Podkarpackie Province



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

An important factor for the development of the aviation and space industry is the present of the large companies in the Podkarpackie Province, including those capable of manufacturing complete aircrafts or aircraft engines, as well as a network of suppliers providing elements and components for their needs. Companies from the Podkarpackie Province are also involved in cosmonautics production. A good example of such enterprises is Ultratech sp. z o.o. company producing e.g. parts for the ARIANE 5 rocket or Safran Transmissions Systems Poland producing main and booster engines for these rockets. Asseco Poland S.A. also operates in the cosmonautics industry, providing solutions for Polish uniformed services and for various institutions and agencies, including ESA[96].

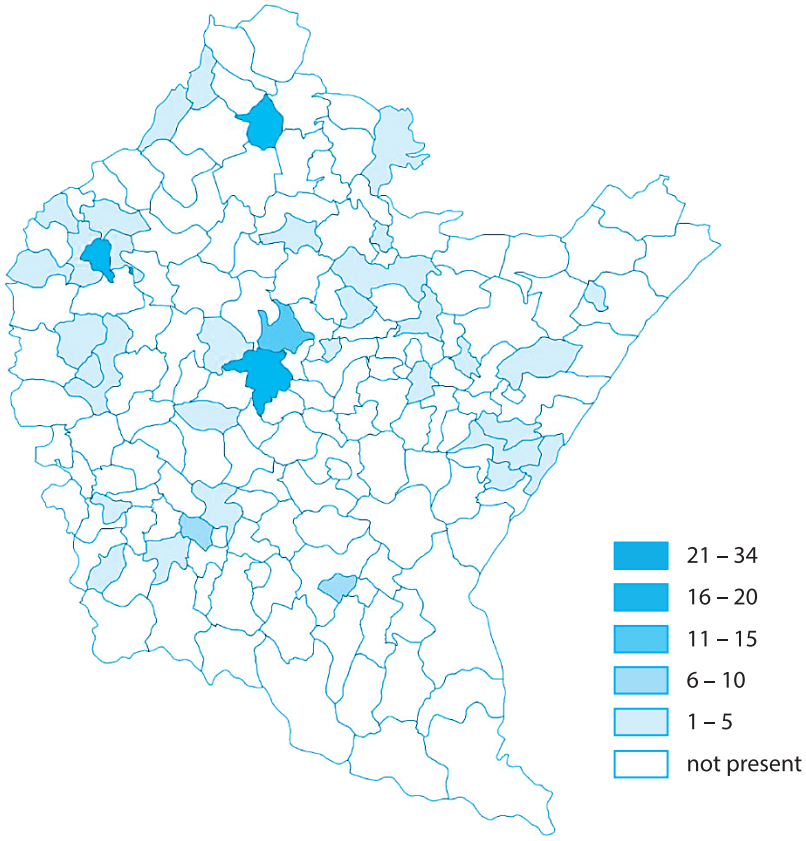
[95] The companies included in the Aviation and Cosmonautics Ishalf include entities classified in the following PCA divisions: 1392, 2219, 2451, 2453, 2540, 2550, 2561, 2562, 2599, 2651, 2670, 2740, 2790, 2811, 2812, 2815, 2899, 2932, 3030, 3312, 3316, 5110, 5223, 7112, 7120, 7219. Comp. *Wiodące branże województwa podkarpackiego – inteligentne specjalizacje regionu*, Rzeszów 2020, p. 12. Dane dotyczą podmiotów o liczbie pracujących 10 and more składających sprawozdanie SP.

[96] *Sięgając gwiazd – polski sektor kosmiczny 4 lata w ESA*, https://www.gov.pl/web/fundusze-regiony/lotnictwo-i-kosmonautyka-motorem-rozwoju-polskiej-gospodarki [access 06.06.2021].

The largest aviation companies are owned by foreign companies. These include: Pratt & Whitney Rzeszów S.A., Polskie Zakłady Lotnicze Sp. z o.o. in Mielec (owned by Lockheed Martin Helicopter Company), Safran Transmission Systems Poland in Sędziszów Młp., MTU Aero Engines Polska in Tajęcin, Collins Aerospace in Krosno and MB Aerospace in Rzeszów.

Smart specialisation Aviation and Cosmonautics is developing mainly in the central, northern and western parts of the province, as evidenced by the distribution of enterprises representing this sector of the economy.

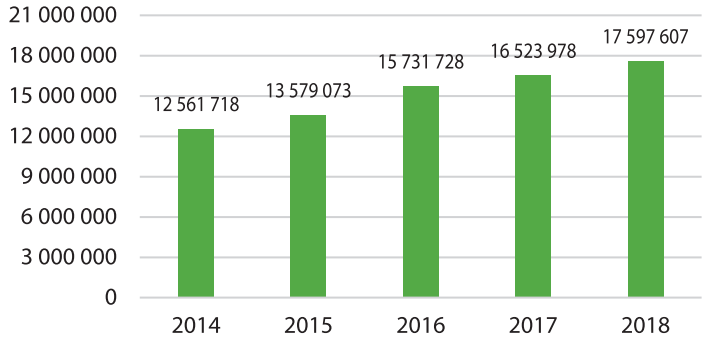
Figure 19. Distribution of units by communes in Podkarpackie Province in 2018 (Aviation and Cosmonautics)



Source: Statistics Rzeszów

The development of Aviation and Cosmonautics smart specialisation in the Podkarpackie Province is evidenced by e.g. growth of revenues from the total activity of enterprises in this sector. In 2018, this metric reached PLN 17.6 billion, which is an increase of 7% compared to the previous year, of 28.3% compared to 2015 and by 74.4% compared to 2010.

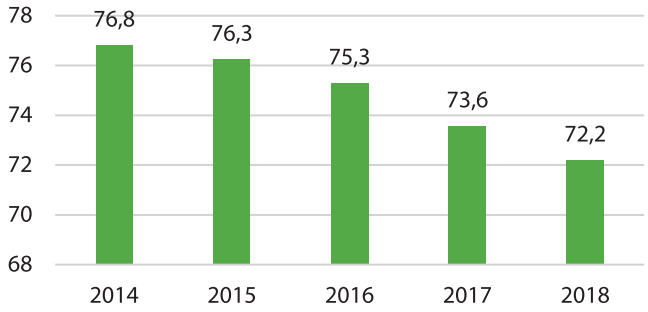
Figure 20. Revenues from total activity of the aviation sector companies



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

In the above period, a systematic decrease in the share of export revenues is visible in the total value of net revenues from the sale of products, goods and materials. In relation to by 2014 it is a decrease of 4.6 percentage points. It should be noted, however, that it is still better result than one achieved in other sectors of the economy dominant in the region. This is thus an additional factor confirming the importance of this industry for the economic development of the province. Aviation companies are among the largest exporters in the region. Turbojet and turboprop engines are one of the most important export products of Podkarpackie Region, while parts for their construction are the most important group of products imported to the region[97].

Figure 21. Share of net revenues from the sale of products, goods and materials for export in net revenues from the sale of products, goods and materials of enterprises in the industry in the Podkarpackie Province [%]



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

The development of specialisation is also evidenced by the number of people working in this industry. In 2018, it was over 39,000 people. In the years 2014-2018, an increase in the dynamics of average employment was visible. The exception was 2017, when a decrease of employment was recorded,

[97] *Handel zagraniczny i bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2013-2019*, op. cit. pp. 36, 42.

although in 2018 it recuperated with increase of 6.3% compared to the previous year[98]. There is also an increase in capital expenditures on new property facilities or on the improvement of existing ones – in 2018 they amounted to PLN 1.55 billion, which was an increase of 55% compared to 2014.

The development of industry that fits into this SS is one of the most important factors contributing to the increase of the pace of the development gap reduction relative to more economically developed regions. The occurrence of the pandemic and resulting economic crisis are factors that have undoubtedly slowed down or even inhibited the development of many enterprises in this industry, and their effects will impact the industry for a longer period of time. It is difficult to clearly determine whether and when it will return to its pre-pandemic state. Due to its importance for the economy of the province, it is important to support activities aimed at accelerating the reconstruction of this branch of the economy.

It should be noted that the aviation industry is constantly developing. The production of unmanned aerial vehicles (so-called drones) is becoming an increasingly important branch of this industry. As the drone can be used for both civilian and military purposes and have an continuously expanding range of applications, it can contribute to an even faster increase in its importance. There are also plans to develop an area related to the development and implementation of other technologies with dual use (i.e. both civilian and military).

The objectives set by the European Union in the challenges of the Green Deal[99]. They call for a reduction in the harmful effects of industry and air transport, including a 90% reduction in transport-related greenhouse gas emissions by 2050[100]. This is a major challenge for the industry. This will require research to look for greener fuels and engines to achieve the targets. Another challenge will also be the search for of solutions in the field of travel safety and their subsequent implementation.

Despite pointing to cosmonautics as one of the areas of this SS, it has been largely dominated by aviation. Production for the needs of the space industry was more of a side project rather than the main activity of enterprises from the Podkarpackie Province. However, the solutions originally developed for the cosmonautics are beginning to have an increasingly wide application in other areas, as exemplified by e.g. various applications of technologies related to satellite navigation.

At the same time, the cosmonautics sector is one of the most innovative and high-tech industries. The high research and development potential of this specialisation is evidenced by e.g. expenditures on R&D activities, which accounted for 0.52% of GDP in 2014, and 0.41% in 2017, with national average equal to 0.14% and 0.2%, respectively. The cosmonautics industry also steadily increases the implementation of the innovative technologies such as 3D printing, allowing to replace metal elements, and thus reduce the weight of airplanes and space vehicles.

Scientific activities carried out by the employees of regional universities and enterprises, are also important for development of specialisation. Scopus, the largest database of peer-reviewed literature, contains almost 350 publications in the field of aviation and cosmonautics submitted from the

98 *Wiodące branże*…, op. cit., p. 17.

99 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_pl [access 17.11.2021].

100 https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/transport-and-green-deal_pl [access 17.11.2021].

Podkarpackie Region. Thus, the share of these publications in the total number of scientific studies published in Scopus is more than six times higher than the average value for the country. This proves the high quality of publications included in the database and their internationalization, as only the monographs and journals that meet certain criteria are indexed in the database.[101]

Entities representing this sector of the economy choose the Podkarpackie Province as their location not only because of the high concentration of aviation companies, what facilitates the creation of supply chains or utilization of the existing ones, but also because of the possibility of active co-operation with research and scientific units specializing in the aviation industry. Aviation companies from the Podkarpackie Province have been cooperating with regional universities for many years, primarily with the Faculty of Mechanical Engineering and Aviation of the Rzeszów University of Technology. It provides education in the field of Aviation and Cosmonautics, with the number graduates steadily rising (in the years 2014-2017 there was almost a twofold increase in the number of graduates)[102]. The international Aviation Management course under the patronage of Lufthansa and LOT Polish Airlines was also introduced by the University of Information Technology and Management in Rzeszów.

The University of Technology is also one of the initiators of the creation and the coordinator of the AERONET Center for Advanced Technologies, whose main area of activity is research, implementation and commercialization of new technologies for the aviation industry. In the region, there are also pilot training centers and scientific and research institutions that create developed educational and training facilities, thus ensuring the development of personnel for the enterprises within this industry.

Aviation companies from the Podkarpackie Province together with universities conduct research in the field of modern materials and coatings for the aircraft manufacturing. They are also developing new technologies in the field of joining (i.a. Block Structures, Friction Stir Welding), or production of details using additive or hybrid methods.

These activities are also carried out in cooperation with the Łukasiewicz Research Network – Institute of Aviation. Rzeszów University of Technology as the project leader together with the Warsaw University of Technology, the AGH University of Science and Technology and the Jeżów Glider Plant built a prototype of the first aircraft using hydrogen cells to power electric propulsion – the AOS-H2 motor glider, the first such prototype in Poland.

Thanks to the investments carried out by scientific units (mainly the Rzeszów University of Technology) and enterprises, this industry has appropriate R&D facilities that can allow for independent implementation of aviation projects. There is also a very high activity of students of universities in the Podkarpackie Province who achieve success in international competitions (e.g. a two-time victory in the University Rover Challenge Competition of Mars rovers). Thanks to these advantages, the Podkarpackie Province gained a worldwide recognition as a centre of the aviation industry. At the same time, Aviation and Cosmonautics are classified as a high-technology industry, thus

101 *Gospodarka województwa*…, op. cit., pp. 65-66.
102 Comp. *System innowacji*…, op. cit., p. 34.

constituting one of the most innovative branches of the economy of the Podkarpackie Region. All these factors mean that the indication of Aviation and Cosmonautics as a smart specialisation of the region, unique in the country is perfectly justified.

In 2019, the ProtoCreativeLab: Space & Aviation, a science club dedicated to cosmonautics was established in the Podkarpackie Innovation Center, primarily to the benefit of students and doctoral students of Rzeszów universities. The plan is to launch three satellites within three years, allowing the research in space, including, e.g. measurement of radiation during the flight or the possibility to use graphene cells for the production of electricity in orbit. The project is also intended to enable biomedical experiments and research related to navigation in the constellation.

Clusters also make an important contribution to the development of smart specialisations in the Podkarpackie Province. Currently, there are three clusters operating in the field of aviation in Podkarpackie Region.

The most important clusters related to this smart specialisation include the Association of aviation industry entrepreneurs' group "Aviation Valley", that currently associates over 170 entities. The main objective of the cluster is to strengthen the role of the south-eastern Poland as one of the leading regions of the aviation industry. It also has the status of a National Key Cluster, what means that the scope of its impact is much greater.

A cluster with a slightly smaller range, but a similar importance for the regional development is Podkarpackie Cooperative Connections – The Light and Ultralight Aviation Cluster, which brings together almost 40 entities. The cluster also cooperates with other clusters, including those from Hungary and New Zealand.

There is also an Unmanned Systems Cluster in the province, which currently includes 13 members. Its goal isto e.g. develop new technologies in the field of unmanned systems.

It should also be noted that the space area of specialisation has a chance to accelerate its development, thanks to e.g. creation of the first cosmonautics cluster. In January 2021, a letter of intent was signed regarding the creation of a cluster, whose signatories, in addition to the Podkarpackie Province, were: Exatel, the Rzeszów University of Technology and the State University of Technology and Economics in Jarosław. The main objective of this initiative is to develop national competences in space technologies and satellite techniques. It will also make it possible to spread the use of these technologies to other sectors of economy[103].

The Aviation and Cosmonautics specialisation shows significant links with other SSs of the Podkarpackie Province, and innovations arising in area of this SS in many cases are implemented in other industries. Therefore, it is important to support the development of both commercial and scientific entities, as well as the research units operating in this area.

[103] https://exatel.pl/polski-klaster-kosmiczny-krok-w-strone-satelitarnego-systemu-obserwacji-ziemi/ [access 28.05.2021].

3.3.2 Automotive

Automotive sector as the smart specialisation of the Podkarpackie Province was indicated at a later stage than other specialisations. As early as in 2014, there were grassroots initiatives aimed inclusion on the automotive industry in the catalog of smart specialisations in the Podkarpackie Region. The emergence of a new leading Automotive specialisation was preceded by a number of activities related to the entrepreneurial discovery process. An important impulse was the report titled *Expert Assessment of the situation and perspectives for Podkarpackie, Poland in view of the development of a RIS* and prepared by experts of the European Commission in 2013, where the automotive industry has been indicated as a prospective sector which, after meeting certain mandatory requirements, could become a smart specialisation of the region[104]. In the RIS3 Strategy adopted in 2015, the automotive industry has been identified as one of the high-opportunity sectors which, upon meeting certain conditions, can become a regional specialisation[105]. In the same year, the Podkarpackie Innovation Council recommended to the Podkarpackie Region Board to start the process of supplementing the list of smart specialisations with the Automotive specialisation. The initiative of industry entrepreneurs, aimed the creation of an automotive cluster, supported by an expert analysis of its development, endogenous conditions, and innovation potential in updating the RIS3 strategy, allowed to indicate the automotive industry as the third leading specialisation of the region[106].

The automotive industry, as well as the aviation, has a long tradition in Podkarpackie Region. The oldest automotive company in the region, AUTOSAN was founded in the 1830s, although a relatively small number of business entities representing the automotive industry are located in the region. Their number has not changed much for several years and in 2018 there were 122[107] of them. It should be noted that most of them are large enterprises with foreign capital that have a global reach (in 2018, large enterprises with 50 or more employees accounted for almost 41.8% of all companies in this industry)[108].

[104] Radzyner A., Hamza Ch., *Report. Expert assessment of the situation and perspectives for Podkarpackie, Poland in view of the development of a RIS*, Metis GmbH, Wien 2014.

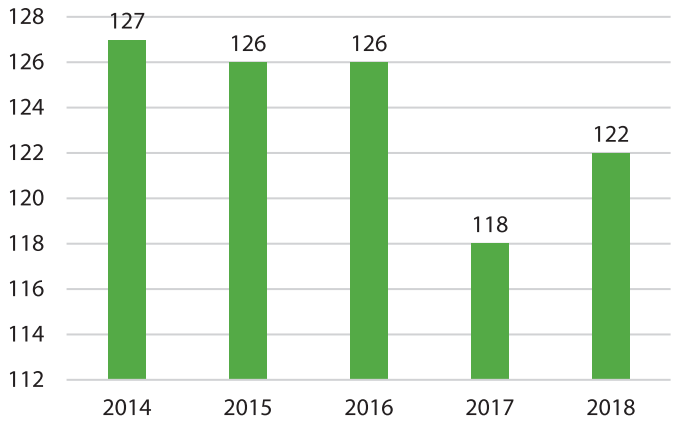
[105] *Regional Innovation Strategy of the Podkarpackie Voivodship for smart specialization 2014-2020 (RIS3)*, Rzeszów 2015.

[106] *Regional Innovation Strategy of the Podkarpackie Voivodship for smart specialization 2014-2020 (RIS3). Aktualizacja 2016*, Rzeszów 2016.

[107] In calculating this value, the units classified in the following PCA divisions were taken into account: 1392, 2211, 2219, 2312, 2651, 2720, 2811, 2830, 2910, 2920, 2931, 2932, 3091, 4511, 4519, 4520, 4531, 4532, 4540, comp. *Wiodące branże*…, op. cit., p. 19.

[108] When calculating this value of this indicator, 122 companies in the automotive industry were taken into account, which submitted F-02 and SP reports. Entities employing at least 10 employees are obliged to submit this report. Thus, the number does not include enterprises with up to 9 employees.

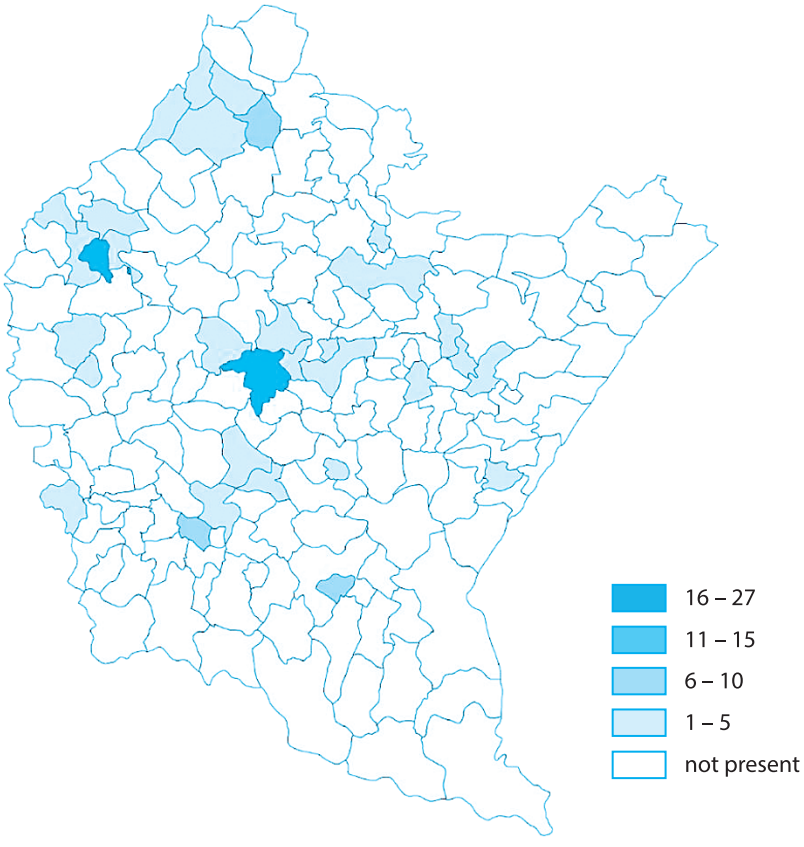
Figure 22. Number of companies from the automotive industry registered in the Podkarpackie Province



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

The highest density of automotive companies is observed – as well as in the case of aviation – in the central, northern and western parts of the province. They are concentrated in SEZs in Mielec, Tarnobrzeg, Rzeszów and in the south of the region. A certain concentration of them also occurs in the vicinity of Sanok.

Figure 23. Distribution of units by communes of the Podkarpackie Province in 2018 (Automotive)



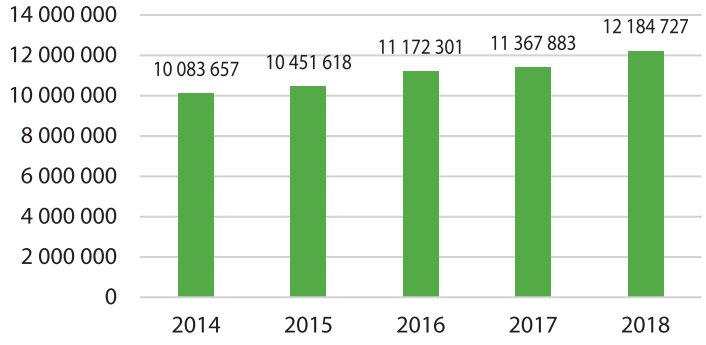
Source: Statistics Rzeszów

The automotive industry is characterized by one of the higher shares in sold production. The automotive industry is characterized by growth dynamics exceeding the average for the province, as well as by a high level of expenditure on innovative activities. There entities that produce final products in the form of a vehicle are not too numerous in the Province, but their activities are very diverse, which means that they have a significant share in the supply of elements and components for the world's leading automotive manufacturers.

Enterprises with foreign capital are of great importance for the development of the industry. The region is also home to automotive companies included in the list of the largest Polish enterprises in this branch of the economy. The TOP 30 ranking prepared in 2018 and based on the data provided by Bisnode Polska included five companies from Podkarpackie Region, three of which were ranked 4th-6th[109]. The participation of such a large number of domestic entities from the automotive industry located in the province proves their potential and international scope of their activities, which well complements the functioning of foreign entities located in the region. It should also be noted that, like in the case of the cosmonautics industry, the automotive sector also conducts production with dual use (civilian and military), an example of which can be the acquisition of Autosan by entities belonging to the Polish Armaments Group.

The level of development of the Automotive Industry is evidenced by good financial results. In 2018, the net financial result reached PLN 673.8 million, while net revenues from the sale of products, goods and materials amounted to PLN 12 billion. Companies representing this SS recorded an increase in revenues from the overall activity. In 2018, it reached the level of PLN 12.2 million, translating to an increase of 7.1% compared to the previous year.

Figure 24. Revenues of the whole activity of the automotive sector in Podkarpackie Province [PLN]



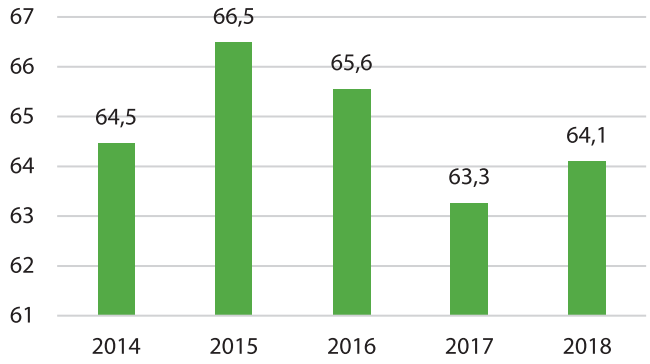
Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

The production of the automotive industry in the Podkarpackie Province focuses mainly on manufacturing components and elements commissioned by global companies, which is why the industry is characterized by a very high level of export of goods. In 2018, the share of net revenues from the

[109] https://www.bisnode.pl/wiedza/newsy-artykuly/lista-top-30-polskiej-branzy-automotive/ [access 19.04.2021].

sale of products, goods and materials for export amounted to 64.1%. Over a few years, this metric displayed only minor fluctuation[110].

Figure 25. Share of net revenues from the sale of products, goods and materials for export in net revenues on sale of products, goods and materials of the enterpises in automotive sector in the Podkarpackie Province [%]



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

The goods most commonly exported in 2019 included non-rail vehicles and their parts and accessories, constituting 10.3% of the total exports of the Podkarpackie Province. It should also be noted that the value of their exports was dynamically increasing. In 2019, it reached PLN 4.12 billion, which was an increase of 71.8% compared to 2013. This is another factor confirming the validity of the designation of the automotive industry as a smart specialisation of the region[111].

The automotive industry is an industry in which over 21,000 people found employment in 2018. Its development also confirms the increase in the dynamics of the average employment in the years 2014-2018 (the only exception was 2017, when a decrease in the index was recorded)[112]. Its development is also evidenced by the value of capital expenditures on new property facilities and the improvement of existing ones. In 2018, their value amounted to PLN 731.2 million, which was an increase of 32% compared to 2014.

The development of this specialisation in the Podkarpackie Province is also possible thanks to the high scientific and research potential. Universities in Podkarpackie Province have extensive laboratory facilities, enabling them to conduct R&D activities in the automotive industry. Particularly active in this area is the Faculty of Mechanical Engineering and Aviation of the Rzeszów University of Technology, that houses the Department of Combustion Engines and Transport.

110 *Monitoring Regionalnej Strategii*…, op. cit., pp. 50-51.

111 *Handel zagraniczny i bezpośrednie inwestycje zagraniczne w województwie podkarpackim w latach 2013-2019*, op. cit., p. 33.

112 *Wiodące branże*…, op. cit., p. 24.

In addition, this area is also characterized by the activity of students. Particularly noteworthy is the activity of the Student Scientific Club PRz Racing Team, which has built two racing cars and carries out design and executive works of the third one.

The region is distinguished by an extensive system of staff training for this sector. Courses related to motorization (in addition to a dedicated faculty of the University of Technology) are also present in the curricula of three universities located in Sanok, Krosno and Przemyśl.

In the Podkarpackie Province, a high level of active cooperation between enterprises belonging to the Automotive pecialization and scientific and research units can be observed. This is another factor testifying to the high level of development of this pecialization in Podkarpackie Province. Among all the universities in this region, the most extensive laboratory capacity related in this branch of industry belong to the Department of Motor Vehicles and Transport Engineering of the Rzeszów University of Technology. It also has a wide range of scientific and research offerings. Companies also join the process of educating staff for the industry, creating patronage classes.

Cooperation between universities in the Podkarpackie Province and automotive enterprises is often implemented as part of cluster initiatives. There are currently 3 clusters associating companies from the automotive industry in Podkarpackie Region. One of the most active clusters is the Eastern Automotive Alliance that currently includes over 30 entities. The cluster's activity focuses primarily on the representation and protection of the interests of entrepreneurs in the automotive industry, including its related co-operators. EAA also undertakes activities to enable industry development, in particular in the Eastern Poland Macroregion. The cluster actively cooperates not only with universities but also with secondary schools in order to adapt staff education to their needs[113]. An example of such cooperation is the implementation of the Podkarpackie Automotive Academy – Innovative Vocational Education (PAMISZ) project, the aim of which includes the improvement of the quality of vocational education, so that it is better aligned to the needs of the labor market.

In the Podkarpackie Province there is also the Polish Automotive Group Association, which has the status of the National Key Cluster. Its goal is to create conditions conducive to the development of Polish enterprises in the automotive industry. The cluster brings together various groups of entities. In addition to manufacturers of automotive parts and components, it also includes research and development units, Business environment institutions and strategic partners[114].

The largest cluster in terms of the number of associated entities is the Industrial and Scientific Cluster 'Sanok Land', which currently includes over 50 entities. The initiator of its creation was the District Office in Sanok. The main objectives of the cluster are both the creation of a cooperation network and supporting innovation and commercialization of the effects of scientific and research[115].

113 http://eaa-wsm.pl/index.php/cel-2/ [access 11.04.2021].

114 https://pgm.org.pl/ [access 11.04.2021].

115 https://powiat-sanok.pl/klaster-przemyslowo-naukowy-ziemia-sanocka/dokumenty/informacje-ogolne-456/ [access 11.04.2021].

Representatives of automotive industry clusters draw attention to barriers to the development of cluster cooperation, such as e.g. the lack of willingness to cooperate on the part of entrepreneurs or the shortage of employees who could be delegated to participate in innovative projects. At the same time, they raise the need for financial support for the cluster activities, including financing of the implementation of projects by developing clusters.

The automotive sector is one of the high-tech ones, meaning that it is one of the most innovative branches of the economy. In addition, it is distinguished as one of the industries that spend the most on innovative activities. Thus, its development makes an important contribution to the increasing of the level of innovation and competitiveness of the entire region. Modern automotive industry is characterized by an increasing usage of information and communication technologies, what leads to the assumption that the entities from the automotive specialisation will cooperate more and more closely with the entities from the Information and Telecommunications smart specialisation. The factors above clearly indicate the legitimacy of further support for this branch of the economy as a smart specialisation of the region.

3.3.3 Information and Telecommunications

The Local Government of Podkarpackie Province has been recognizing the importance of the ICT industry for the socio-economic development of the region for many years. In the *Update of the Regional Innovation Strategy of the Podkarpackie Province for 2005-2013* from 2011, IT services were indicated among high-opportunity sectors, i.e. ones that have the potential to become the pillars economy of the province[116].

The *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020* (RIS3), adopted in 2015, identified the area of Information and Telecommunications as the smart specialisation of the region. This specialisation was selected during successive meetings and consultations. This was greatly influenced by both the needs for the development of information and communication technologies of the two previously identified specialisations (i.e.: Aviation and Cosmonautics and Quality of Life), as well as data presented in the report *Mapping the European ICT Poles of Excellence: The Atlas of ICT Activity in Europe*. They pointed to the potential of the IT industry, counting the Rzeszów subregion among the leading European areas, where the IT sector experiences the fastest growth[117].

As an industry development of which has a greater or lesser impact on all branches of the economy of the Podkarpackie Region, ICT has been indicated as a horizontal supporting specialisation, which is to strengthen the level of competitiveness and innovation of other specialisations.

116 *Aktualizacja Regionalnej Strategii Innowacji Województwa Podkarpackiego na lata 2005-2013*, Rzeszów 2011.

117 De Prato G., Nepelski D., *Mapping the European ICT Poles of Excellence: The Atlas of ICT Activity in Europe*, Publications Office of the European Union, Luxembourg 2014.

ICT is one of the most dynamically developing branches of the economy. Information and communication technologies are used in almost every sphere of life, thus playing an increasingly important role for socio-economic development. The importance of this industry will undoubtedly continue to grow in the coming years. This is related, to e.g. the emphasis placed on the development of the information society and digitalisation by the EU. This is one of the policies of the new financial perspective, both at national and European level[118].

Digitalisation is one of the main pillars of the fourth industrial revolution. Industry 4.0 brings with it the spread of the use of new information technologies, mobile, machine learning, as well as artificial intelligence[119]. The implementation of solutions in the field of information and telecommunications technologies will increasingly become a prerequisite for maintaining the level of competitiveness of enterprises. This applies not only to the so-called high-tech sectors, but also more and more often to these more traditional branches of the economy.

The occurrence of the COVID-19 pandemic has strongly accelerated the development of the implementation of technologies and digital solutions in both enterprises and public institutions. The demand for computer hardware and mobile devices for remote work and learning has increased, as well as the demand for telecommunications infrastructure. This factor (along with the progressive revolution of Industry 4.0) is an opportunity to accelerate the development of ICT industry enterprises in the region.

The specialisation of ICT makes it difficult to monitor its development due to the statistical confidentiality of data on enterprises in this sector at the regional level. The lack of available data also prevents the use of the analysis system that was adopted when describing the specialisation Aviation and Cosmonautics and Automotive. Nevertheless, an attempt was made to diagnose the development of the industry on the basis of available data.

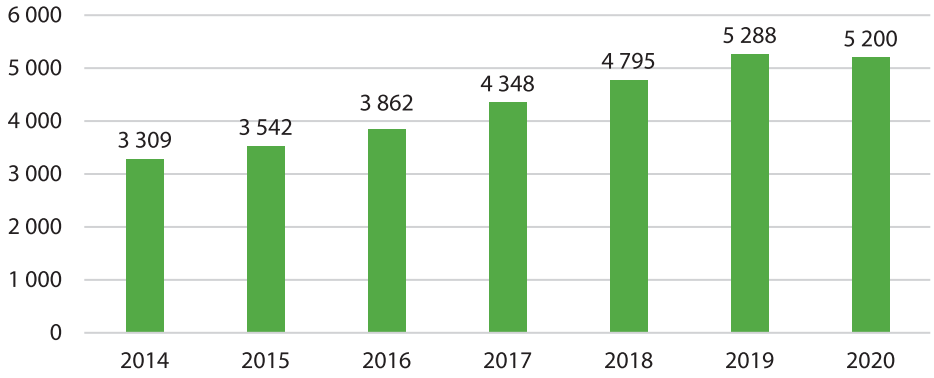
According to data gathered by the General Statistical Office, in 2019 there were 5288 entities of the national economy operating in the field of telecommunications, software and consulting in the field of IT and providing information services in the Podkarpackie Region (divisions 61-63 of section J of the PCA). This is necessary a relatively small number compared to other regions. It should be noted however that it was subject to systematic growth. Only in 2020 can a slight decrease be observed.

According to Statistics Poland data, the dominant type of business conducted by ICT industry enterprises in the province is an area related to software and consulting in the field of IT that account for 79% of all ICT business entities in the region in 2020 what make it 10th in the country in this regard. It should also be emphasized that this is an increase by 8 percentage points compared to 2015. In terms of the share of other groups of companies, the region reached the 7th position in both cases.

118 *Projekt Umowy Partnerstwa dla realizacji polityki spójności na lata 2021-2027 w Polsce,* Warsaw 2021.

119 *Gospodarka województwa*…, op. cit., p. 28.

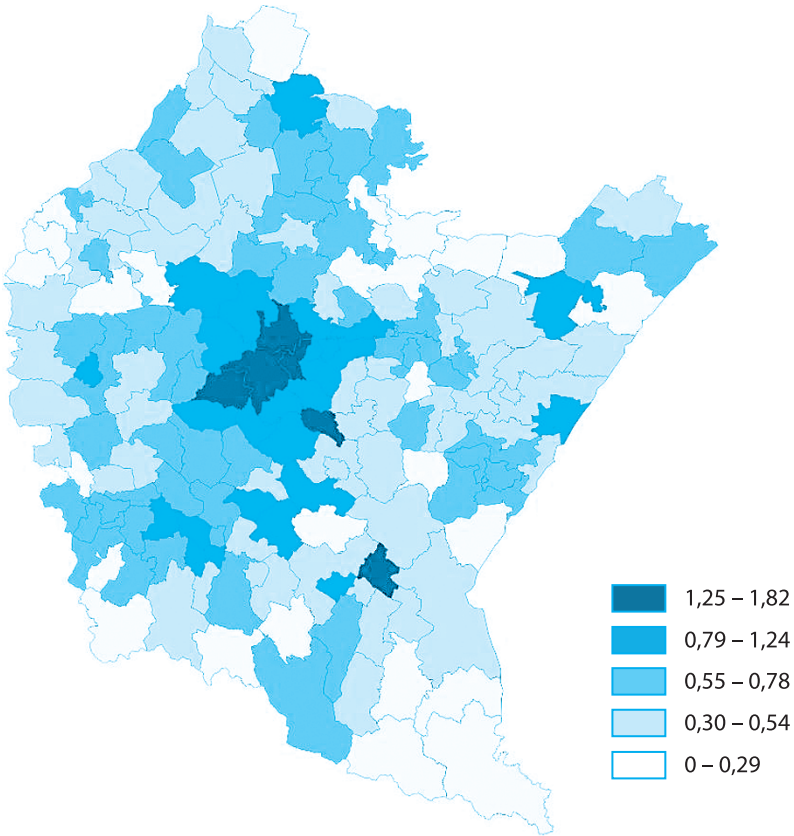
Figure 26. Number of the companies from ICT sector registered in the Podkarpackie Province



Source: *Monitoring Regionalnej Strategii Innowacji Województwa Podkarpackiego na rzecz Inteligentnych Specjalizacji – 2020*, Rzeszów 2020

Enterprises of the ICT industry of Podkarpackie Region are concentrated mainly in large cities of the province or in their immediate vicinity. The highest concentration of them (as evidenced by the quotient of the concentration of ICT entities) occurs in the capital of the region.

Figure 27. A product of locations of the ICT entities in the communes of the Podkarpackie Province in 2019



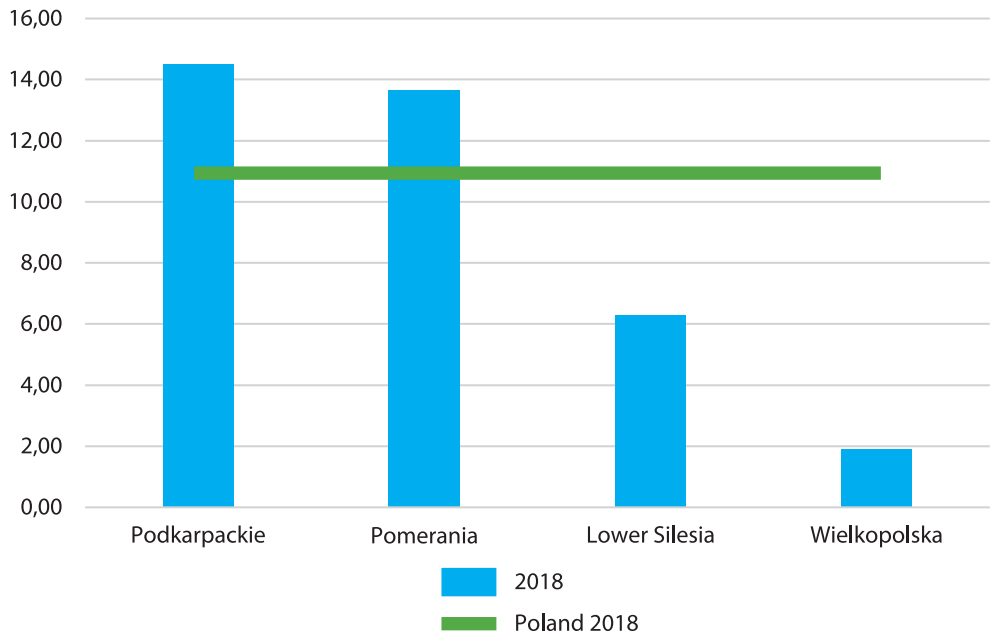
Source: *Inteligentna specjalizacja województwa podkarpackiego Informacja i telekomunikacja na tle regionów kraju i UE*, Warsaw 2020

The largest IT company in the country, Asseco Poland, a software producer listed on the Warsaw Stock Exchange is also based in Rzeszów. In 2019, the company registered sales of PLN 10,667 million, while the operating profit amounted to PLN 976.2 million. The company has an international reach – it operates in 56 countries. Sales on foreign markets account for almost 90% of the company's revenue[120].

Podkarpackie Region belongs to the regions distinguished by the resources of both scientific and research potential as well as education in the field of ICT. In the ranking included in the report 'Mapping the European ICT Poles of Excellence: The Atlas of ICT Activity in Europe' that takes into account the value of the indicator on investments in intangible assets of companies, Rzeszów subregion was ranked 30th, although it was ranked 2nd in terms of employment growth rate in ICT and 3rd in terms of the ICT companies turnover[121].

The analysis of R&D cooperation metrics also indicates the relatively high innovation potential of the ICT industry. In 2018, ICT enterprises in the Podkarpackie Region were characterized by relatively high internal expenditures on R&D activities per one employee.

Figure 28. Internal outlays in the sector of the R&D activity in the divisions 61-63, section J per 1 worker in these sections [PLN]



(due to the lack of availability of data at the level of the entire section J, the number of employees was calculated by a proportionate reference to the number of entities registered in each section; data for the Pomerania Province from 2017, as the 2018 data were classified at the time)

Source: *Inteligentna specjalizacja województwa podkarpackiego Informacja i telekomunikacja na tle regionów kraju i UE*, Warsaw 2020

120 https://inwestor.asseco.com/raporty/raporty-okresowe/2019/ [access 14.04.2021].
121 *Mapping the European ICT Poles of Excellence*…, op. cit.

According to the data of the Patent Office of the Republic of Poland, in the period 2015-2020 the entities from in the Podkarpackie Province registered 35 devices related to the Information and Telecommunications specialisation and focusing on the electronic data processing, communication and quality of life devices for people with disabilities, control systems and electronic ICT devices. A definite leader in this area is the Rzeszów University of Technology, which has registered 15 inventions and patents. The remaining applications were filed by private companies[122].

The potential of the ICT industry to increase the level of innovation and competitiveness of the Podkarpackie Province is evidenced by the i.a. active cooperation by enterprises in this sector. There is a rapidly developing IT cluster in Podkarpackie Region, that more than quadrupled its number of members between 2012 and 2017. The Eastern Poland Cluster of IT Companies, coordinated by the 'Informatyka Podkarpacka' Association, currently associates over 100 entities related to the telecommunications and IT industry, universities and EBIs, including 84 from Podkarpackie Region. A cluster related to the ICT specialisation is the Cluster of Photonics and Fiber Optics in Lublin, in which 5 entities from the Podkarpackie Region operate.

Representatives of clusters draw attention to the limitations in their development, related to e.g. the inability to finance the cluster's activities from sources other than membership fees, the volatility of support instruments, lack of involvement of cluster representatives in their cluster formation and not entirely clear legal conditions regarding running a business, forcing the entrepreneurs to spend time and energy on adaptation activities rather than on search for development methods.

At the same time, in addition to the areas mentioned above, representatives of clusters indicate the needs for construction of the brand and recognition of the cluster and its promotion, support for enterprises of the SME sector in the area of protection of intellectual property rights, animating the transfer of knowledge and experience as well as international cooperation or support in the area of communication and IT tools improving cooperation and networking.

Companies that are part of the ICT specialisation also actively cooperate with universities in the form of: barter cooperation (i.e. non-cash cooperation based on the exchange of services / products), participation in projects supporting the development of start-ups, or joint organization of events and conferences[123].

The development of this branch of the economy is also evidenced by the extensive system of staff education. Academic courses related to Information and Telecommunications are offered by most of the largest universities in Podkarpackie Region, including both the University of Technology and the University of Rzeszów. Future employees of the ICT industry are also educated in over 60 secondary schools in Podkarpackie.

122 Ibidem, p. 24.

123 *Inteligentna specjalizacja*…, op. cit., p. 29.

The Podkarpackie Province belongs to regions with relatively well-developed scientific and research potential in the field of information and communication technologies. The largest scientific center is the Rzeszów University of Technology. Research related to the application of ICT technology is also conducted by the University of Information Technology and Management in Rzeszów. The research and scientific potential are also visible in the relatively large expenditures on R&D activities per 1 employee in the regional enterprises[124]. The possibilities of specialisation development are also evidenced by the successes of students of Podkarpackie universities at international programming competitions.

The development of information and communication technologies and their impact on all areas of socio-economic life means that ICT smart specialisation will be increasingly important for the development of the region. Therefore, it is important to support the development of this industry, that can contribute to increasing the innovativeness and competitiveness of other Podkarpackie Region smart specialisations through the use of innovative solutions developed by ICT enterprises.

3.3.4 Quality of Life

Due to the fact that the Quality of Life specialisation areas do not form one industry, each of them is distinguished by a slightly different growth dynamics. Due to the wide range of SS, it also makes it difficult to monitor its development. For this reason, as well as due to the lack of availability of much data, it is not possible to use a similar analysis system as it was in the case of the specialisation Aviation and Cosmonautics and Automotive. In addition, the data represent industry groups rather than individual industries that make up the specialisation.

The structure of enterprises specializing in The Quality of Life was dominated by medium-sized enterprises, accounting for 62.7% of all enterprises[125].

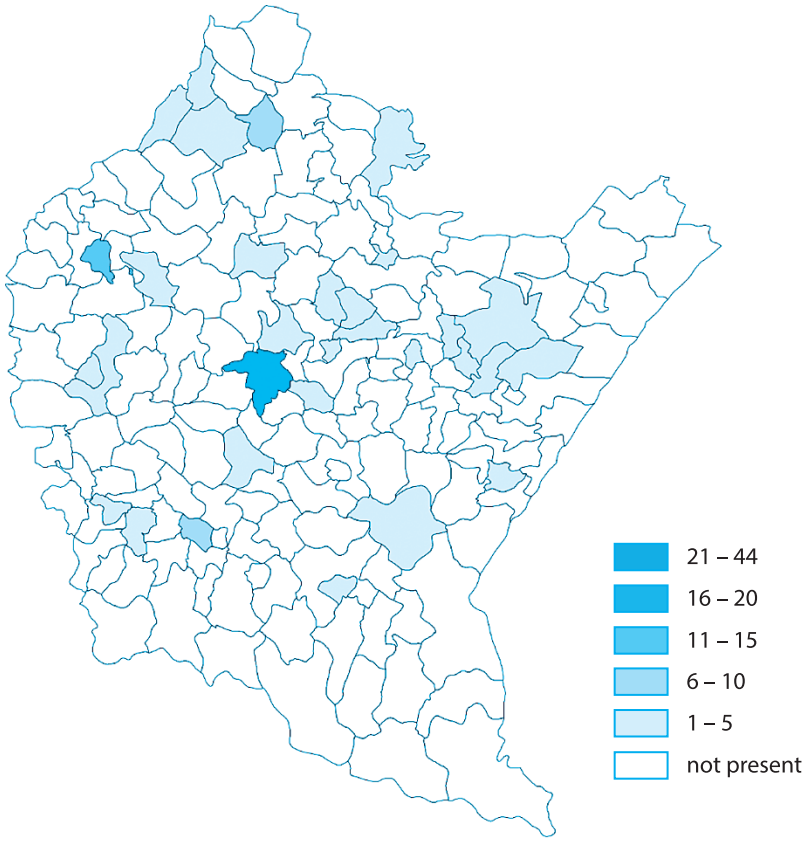
In the case of the area related to climate and energy (which is one of the elements of specialisation), the number of enterprises fluctuated in the years 2014-2018. In 2018, there were 150 of them[126], which is almost 12% lower than in 2014.

[124] *Inteligentna specjalizacja*…, op. cit., p. 32.

[125] Reporting F-02 and SP.

[126] For the purposes of this analysis, the term energy security and mobility should be understood as units classified into the following PCA divisions: 23.11, 26.11, 27.20, 27.51, 27.52, 35.11, 35.12, 35.21, 35.30, 39.00.Z, 41.10, 41.20, 49.10, 49.31, 62.01, 62.09, 72.11, 72.19, por. *Wiodące branże*…, op. cit., p. 28.

Figure 29. Spatial distribution of entities in the area of energy security and mobility in Podkarpackie Province in 2018



Source: Statistics Rzeszów

Similar variable trends occurred in financial metrics. In 2017- 2018, enterprises in this industry operating in the Podkarpackie Province recorded an increase in both revenues and costs of business activity.

The share of exports in sales revenues in units specializing in energy security and mobility due to the specificity of their operations in 2018 accounted for only 4.5% of total net revenues from the sale of products, goods and materials. For business entities related to energy security and mobility, the first degree liquidity ratio in 2014-2018 remained above the average value for Podkarpackie Region, achieving 34.9% in 2014, and raching its highest value of 51.7% in 2017.

For the entities belonging this industry, following the initial growth in 2014, it was possible to observe systematic decreases in the level of the average employment compared to the previous year. A renewed, albeit slight increase (by 1.4%) occurred only in 2018. This year, just over 12,000 people found employment in the industry. The decrease was also visible in the value of the investment aimed at the creation of new existing property facilities or improvement of the existing ones. In the years 2014-2017, a significant decrease can be observed, only in 2018 they increased to PLN 360 million, which is a value 22.3% lower than in 2014.

Due to natural conditions, including relatively high insolation, Podkarpackie Region has good conditions for the development of energy based on renewable energy sources[127].

Energy production in the Podkarpackie Province, increased from 2,662.3 GWh in 2010 to 2,746.0 GWh in 2019, with a simultaneous increase in renewable energy production from 315.7 GWh in 2010 to 658.9 GWh in 2019. During this time, the share of energy from renewable sources increased from 11.9% to 24% in 2019. This ranks Podkarpackie Region 7th in the country in terms of the share of renewable energy in total electricity production. Hydroelectric power plants and renewable fuels are of the greatest importance for the production of renewable energy in the province (in 2019 it amounted to 558.7 GWh)[128].

Due to the increasing emphasis placed by the European Commission on issues related to environmental protection and the need to develop renewable energy sources, this industry will be increasingly important for the region's economy. Undoubtedly, one of the activities conducive to the development of this branch of the economy will be the creation of the first 'Hydrogen Valley' in the Podkarpackie Region, the operation of which will be an element of the European Commission's postulate of striving to achieve climate neutrality. On May 18, 2021, a letter of intent was signed by the Marshal of the Podkarpackie Province and representatives of the largest Podkarpackie scientific units, the Institute of Energy, as well as the entrepreneurs (including in particular those representing the energy sector) and administration headed by the Voivode of the Podkarpackie Province. The signatories of the letter agreed to cooperate in the field of conducting R&D works and implementing their results, as well as making the necessary investments. The aim of these activities will be to create common value chains in the area of the hydrogen economy. In addition, the Hydrogen Valley will be a space for discussion, exchange of knowledge, building and strengthening business contacts in areas related to the hydrogen economy. It may fulfill also educational role in the scope of the possibility to use the hydrogen technology. It is assumed that five such hydrogen valleys will be created in the country[129].

Despite the visible decrease in the number of enterprises related to the energy sector, and thus often a decrease in the level of employment, and despite the decrease in the investments, the Local Government of Podkarpackie Region sees opportunities for the development of this industry, resulting from e.g the EU policy regarding the increased use of renewable energy sources. The scale and pace of its development, the ability to network cooperation, as well as the research and development potential is not sufficient to make RES an independent pecialization of the region. Therefore, in order to provide opportunities for further development, the area related to renewable energy will remain one of the elements of the remodeled Quality of Life specialisation.

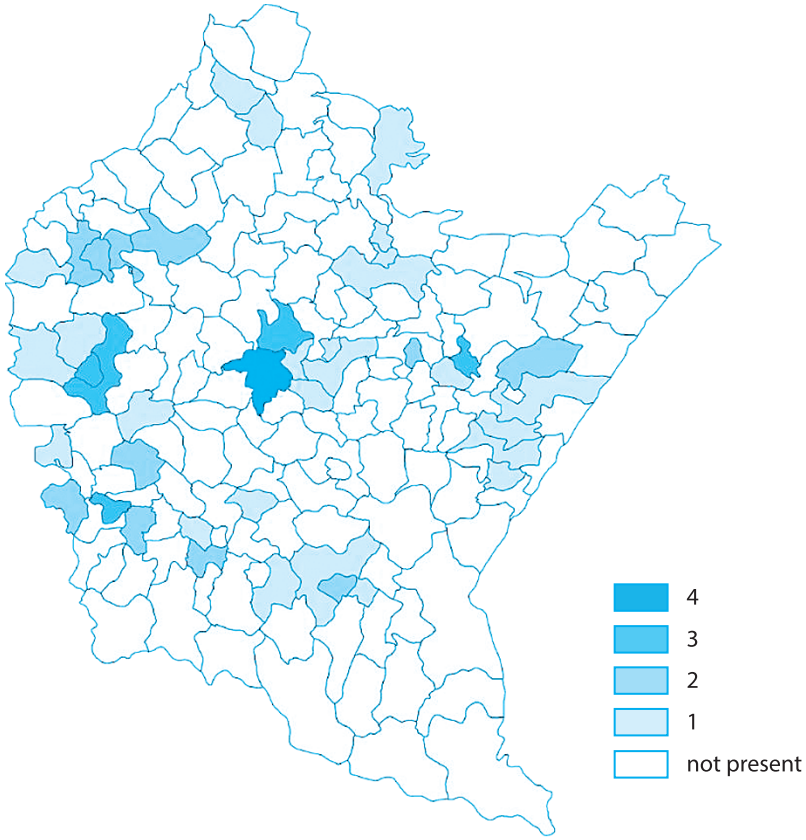
127 *Program Ochrony Środowiska dla Województwa Podkarpackiego na lata 2017-2019 z perspektywą do 2023 roku.*

128 *Przegląd regionalny*…, op. cit., pp. 241-243.

129 129 https://podkarpackie.pl/index.php/107-aktualnosci/8274-pierwsza-dolina-wodorowa-powstanie-w-rzeszowie [access 20.05.2021].

Certain changes are recorded also by the sector connected with the food safety in Podkarpackie Province. According to data collected by the Statistics Poland, in 2018 there were 91 entities belonging this sector in the region[130]. This represents a decrease of 12.5% compared with 2014. More than 56% of them were small enterprises with 10-49 employees. It should be noted, however, that the Statistics Poland data presented above do not include micro-enterprises, what may significantly distort the image of the entrepreneurial structure of this industry.

Figure 30. Distribution of the units by the communes of the Podkarpackie Province in 2018 (food security)



Source: Statistics Rzeszów

At the same time, the data of the Statistics Poland shows that there is a relatively large number of business entities operating in the area of industrial processing related to the production of food and beverages. In 2020, it was a total of 1489 entities, making the Province 11th in the country in this regard.

130 *Wiodące branże*…, op. cit., p. 33. Data concerning the number of the entities is calculated on the basis of the reports PP submitted by the enterprises employing at least 10 employees. When calculating it, units classified into the following PCA divisions were taken into account: 01.11, 01.12, 01.13, 01.14, 01.15, 01.16, 01.19, 01.21, 01.22, 01.23, 01.24, 01.25, 01.26, 01.27, 01.28, 01.29, 01.41, 01.42, 01.43, 01.44, 01.45, 01.46, 01.47, 01.49, 01.50, 02.30, 10.11, 10.12, 10.13, 10.20, 10.31, 10.32, 10.39, 10.41, 10.51, 10.52, 10.61, 10.62, 10.71, 10.72, 10.73, 10.81, 10.82, 10.83, 10.84, 10.85, 10.86, 10.89, 11.02, 11.03, 11.04, 11.05, 72.11, 72.19.

In 2018, 8631 people worked in the food security sector. This number rose since 2014 by 9.9%. The dynamics of the average employment in this period recorded slight increases (with the exception for 2016, when this indicator reached 97.2% compared to the previous year).

A positive trend is the systematic increase in revenues from the entire activity of this industry, which in the years 2014-2018 increased by 39.4%, reaching the value of PLN 3.5 billion. Net revenues from the sale of products, goods and materials were slightly lower (PLN 3.4 billion in 2018).

The importance of the area related to food production for the development of the region can also be evidenced by the fact that the category 'various food products' has a high position in the list of the most important export products in terms of goods. It should be noticed that this industry records systematic growth of export value – in 2019 it was 560.4 mln PLN, a threefold increase in comparison with 2013. This is at the same time one of the categories of export products which is characterised by high dynamics of changes (in the period 2013-2019 the value of export grew on average by 20.1% per annum). The import of food and food products is also distinguished by high growth dynamics. In total 2018 the net revenues obtained by the sector food security from the sale of products, goods and materials for export accounted for 26.6% of the total net revenue from the sale of products, goods and materials.

Entrepreneurs operating in the area of food security invest in the development of their companies, what can be seen in an analysis of the value of investment outlays they incur for new property facilities and the improvement of existing ones. In 2018 their value amounted to slightly above 220 mln PLN, what means increase of 39.6% in relation to 2014.

When analyzing the industry related to food production, an important area related to agricultural production cannot be overlooked. The Podkarpackie Province has been characterized by a large fragmentation of agriculture for years. In 2019, the average area of a single agricultural homestead was only 4.44 ha, what was one of the lowest results in the country. As many as 38.6% of all homestead had only 1.2 hectares of agricultural land. It should be noted, however, that the number of farms is decreasing while the average agricultural area is growing slightly. This may indicate that farmers see a need to increase the area of their land in order to increase the efficiency and profitability of agricultural production.

Organic food production in the region is not developing according to the trends that can be observed in the country. The share of certified ecological agricultural land in the total agricultural land area decreased from 4.08% in 2010 to 2.08% in 2018, when in the same period, e.g. in the Podlasie Province, the opposite trend could have been observed. The amount of land used for organic farming has been decreasing since 2014, reaching 13,757 thousand ha in 2019, what mans a decrease by 9.7 thousand ha relative to 2014. This is caused by e.g., a decrease in the intensity of production and, as a result, the productivity of the land.

Share of export in sales revenues in units specializing in production and food processing was 16.0%–26.6%. For economic entities related to food security, the first degree liquidity ratio (meaning the ability of enterprises to pay liabilities immediately) in 2014-2018 remained below the average value for the Podkarpackie Region (the lowest in 2014 – 19.6%, the highest in 2015 – 25.1%).

Podkarpackie Province has the largest number of traditional products included in the list of the Ministry of Agriculture and Rural Development. In 2020, there were 247 of them, i.e. 23 more than in the runner-up, Małopolska Province.

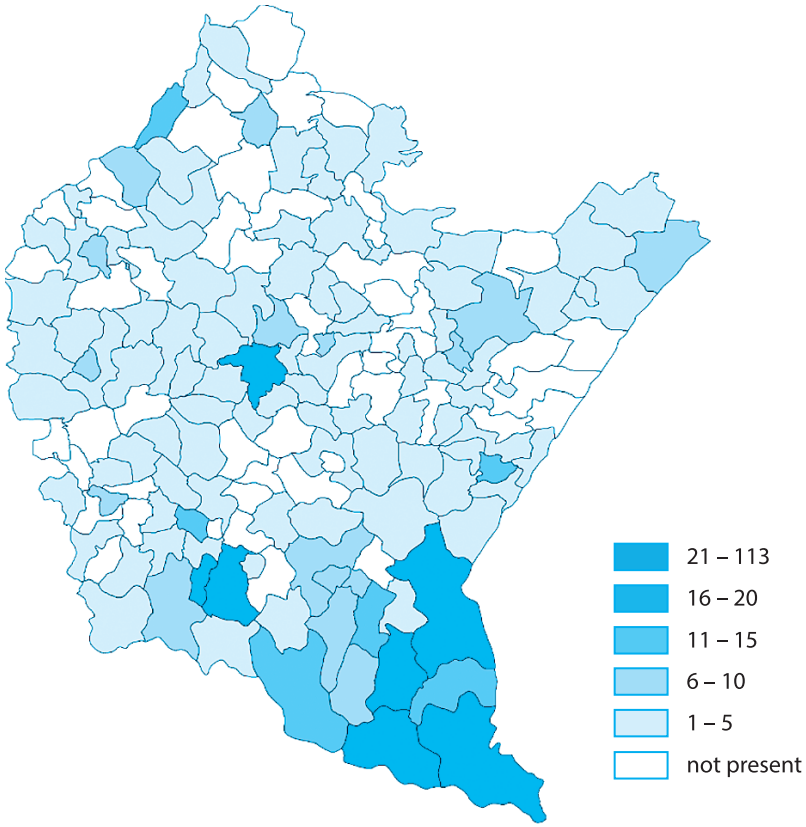
The data presented above in the scope of e.g., the structure of enterprises or the size of employment and export indicate that the food production industry currently does not have the potential to become an independent specialisation of the region (it does not meet the regional criteria for the identification of specialisation), but it is large enough to indicate the area of food production as one of the pillars of the current Quality of Life SS in the RIS of the Podkarpackie Province.

Podkarpackie Province is one of the cleanest regions in the country. Multicultural traditions and historical heritage are conducive to the development of tourism. Increased transport accessibility of the region, thanks to e.g., A4 motorway, the construction of the S19 expressway, or the international airport, allows better access to attractive locations for both domestic and foreign tourists. This factor, together with natural and cultural values and a relatively good level of tourism infrastructure, is a potential for the development of tourism in the region. Therefore, this area is an important element of the Quality of Life SS. The increasing tourist attractiveness of the region is also influenced by the progressive revitalisation of cities and rural areas.

There is a constant development of this industry in the region, visible, among others, in the increase in the number of overnight stays granted per 1000 inhabitants, that has increased from 968.00 in 2010 to 1,693.15 in 2019. In the same period, the number of tourists using overnight stays per 1000 inhabitants almost doubled, increasing from 327.66 in 2010 to 609.66 in 2019. The level of accommodation usage in the Province increased from 30.9% in 2010 to 34.8% in 2019.

The number of tourist accommodation facilities is also increasing. In 2014 in the area of Podkarpackie Province there were 513 tourist night facilities and in 2018 their number rose to 642. They accounted for 5.8% of all facilities in Poland (7th place in the country).

Figure 31. Spatial distribution of tourist accommodation facilities in the Podkarpackie Province in 2018



Source: Statistics Rzeszów

The basic tourist accommodation facilities include hotel facilities. In the region there were 232 hotel facilities (their number increased by 35 compared to 2014), including: 149 hotels, 6 motels and 16 guesthouses[131]. In 2018, they accounted for 5.6% of all hotel facilities in Poland. In 2018, the largest group of hotels in the Podkarpackie Province were three-star hotels (74 facilities) and two-star hotels (42 facilities). In 2018, 9 one-star, 16 four-star and 1 five-star hotels also operated. The largest number of tourist accommodation facilities is located in the leskie, bieszczadzkie and krośnieńskie districts.

The number of beds in tourist accommodation facilities in the Podkarpackie Province is constantly increasing, in 2018 they had a total of 34.7 thousand beds, constituting 4.3% of such places in the country (9th place). The number of beds increased compared to 2014 by 7.1 thousand. In 2018, 1263.4 thousand tourists used tourist accommodation facilities in the Podkarpackie Province, what is an increase by 390 thousand in comparison with 2014. The foreign tourist comprised only a small part of that number, amounting to approx. 12%. Despite a significant increase in their number (compared to 2014, it is an increase by 46 thousand people), the share in accommodation provided to foreign tourists in the country amounted to only 2%.

[131] Data for 2018 according to Statistics Poland Local Data Bank. According to the definition of Statistics Poland, the guesthouse is 'facility that provides hospitality services complete with all-day meals and has at least 7 rooms. Must provide catering services in the form of serving at least two meals a day'.

In the Podkarpackie Region, tourist facilities focus to a large extent on areas where there is no highly developed industry, which is their undoubted advantage. This may be evidenced by the increase in the number of agritourism accommodation units from 26 in 2010 to 60 in 2019[132]. In the same period, the number of places in agritourism facilities increased from 386 to 974. It should be noted, however, that it is lower than in 2016, when it peaked at 1120 facilities. At the same time, the number of guest rooms/private accommodation[133] increased by 93% in the same period. For their owners, income from agritourism activities is an additional rather than the main source of income. This may be one of the reasons for the relatively low level of development of this type of tourism in the province.

One of the most recognizable tourist brands of the Podkarpackie Province are the Bieszczady Mountains, which attract many tourists from outside the Podkarpackie Region every year. In 2020, the tourist traffic on the trails of the Bieszczady National Park amounted to 373.3 thousand people, i.e. 37% more than in the previous year[134]. However, it should be noted that such a high increase of the number of visitors to the Park probably was, to a large extent, a result of introduced restrictions on foreign trips, encouraging many tourists to spend their holidays in the country.

The tourist potential of the Podkarpackie Province is also influenced by the areas of the Low Beskid and Roztocze regions characterized by high natural values, relatively developed infrastructure that includes agritourism, making them an attractive tourist destinations for people seeking tranquility and peace[135]. In the area of the Low Beskid, an Area of Ambitious Tourism (AAT) was established, to which 12 municipalities acceded. Thanks to the networking of cooperation and attempts to create common tourism products, it is conducive to the increase of the tourist potential of this area.

In the region there is a relatively well-developed spa treatment, which is a potential for the development of this type of tourism. Mineral waters, healing peat and microclimate occurring in the region are the basis for 5 spas: Iwonicz-Zdrój, Rymanów Zdrój, Polańczyk, Horyniec-Zdrój and Latoszyn-Zdrój. In 2019, a total of 61.4 thousand patients were in hospitals and sanatoria. This value allowed Podkarpackie Region to rank 6th in the country136.

Popular tourist attractions in the region include: Łańcut Castle Museum, the City of Przemyśl and the Przemyśl Fortress, Glass Heritage Centre in Krosno, Ignacy Łukasiewicz Museum of Oil and Gas Industry in Bóbrka, Museum of Folk Construction, or the Beksiński's Gallery in Sanok. The Podkarpackie Region also has a rich enotourism offer related to with the development of the Carpathian

132 The data comes from the Statistics Poland Local Data Bank. According to the definition of the Statistics Poland , the agritourism accommodation unit is 'Type of object tourist accommodation, which consists of rooms and residential houses as well as adapted farm buildings (after adaptation) in rural farms (agricultural, livestock, horticultural or fishing) owned by farmers, rented to tourists for overnight stays for a fee'.

133 As a definition of guest rooms/private accommodation, the Statistics Poland states that it is 'a type of accommodation facility tourist accommodation, which consists of furnished rooms and premises (with the exception of agritourism accommodation) in apartments, homes and other residential buildings belonging to natural or legal persons (with the exception of farmers), rented to tourists for accommodation for a fee'.

134 https://www.bdpn.pl/index.php?option=com_content&task=view&id=3014&Itemid=1 [access 20.05.2021].

135 *Strategia rozwoju i komunikacji marketingowej turystyki województwa podkarpackiego na lata 2020-2025*, Annex to Resolution No. 167/3530/20 of the Management Board of the Podkarpackie Province in Rzeszów of June 16, 2020.

136 *Przegląd regionalny*…, op. cit., p. 130-131.

Wine Route. It includes vineyards and enotourism farms that offer wine tasting and provide knowledge of viticulture and wine production.

Podkarpackie Province also has the potential for the development of religious and pilgrimage tourism due to the location of religious cult centers in the region (Leżajsk, Jarosław, Kalwaria Pacławska), a wooden architecture trail entered in the UNESCO register, places associated with saints and blessed persons (Korczyna, Dukla, Strachocin, Plac Piastowe, Komańcza).

The Statistics Rzeszów overestimated financial data for the tourism and health industry[137]. The analysis of the level of revenues from the overall activity of these industries shows a systematic decrease in the index in 2014-2016. In 2017, the index increased by 43% compared to the previous year, reaching the value of PLN 1.12 billion. After such a high increase in the following year, there was an equally high decrease, dropping the value of the indicator to a level close to that of 2014. Slightly greater fluctuations can be observed in analysis of the net revenues from the sale of products, goods and services, which also reached the highest value in 2017 (PLN 1.02 billion). In the following year, this value was already 24.8% lower. These industries, for obvious reasons, have a much lower export potential, but in 2018 0.4% of net revenues from the sale of products, goods and materials were net revenues from export sales.

Tourism in the Podkarpackie Province, excluding spa tourism, is characterized by high seasonality. The largest number of tourists falls on holiday months – the number of overnight stays during this period accounts for almost 30% of all overnight stays granted during the year.

Despite the undeniable potential of the industry and its importance for the economy of the Province, there are not many branded tourism products recognizable in the region and abroad. Apart from health resorts, there are also not many year-round facilities, the cultural and entertainment offer of which would allow to increase tourist traffic in the off-season. These factors mean that this industry is developing at a much slower pace than in the neighboring Małopolska Province.

Despite its seasonality, it is an industry with a relatively large potential. It is also important for the development of the Province, especially its southern part, where (due to e.g., the presence of a large number of protected areas), development of other branches of the economy is difficult.

Podkarpackie Province also has some potential in the production of medicines and dietary supplements. In 2019, 14 entities entered into the REGON register were located in Podkarpackie Region were producing basic pharmaceuticals, medicines and other pharmaceutical products (Section C, Division 21 of the PCA). This number has fluctuated slightly in recent years, but ultimately allowed the region to be ranked 12th in the country in this regard. It should be noted that despite the relatively small number of entities, these are mostly large companies with their own recognizable brands. In addition, since 2017 the industry is characterized by a positive growth rate of sales, what makes this region a national leader. In 2019, the value of sold production of the industry of basic pharma-

[137] Estimates based on F-02, SP and KT-1 reports with a workforce of 10 or more. For the purposes of this analysis, the term tourism and health should be understood as units classified into the following sections of the PCA: 21.10, 49.39, 52.21, 55.10, 55.20, 55.30, 55.90, 56.10, 56.21. 56.29, 56.30, 72.11, 72.19, 77.21, 79.11, 79.12, 79.90, 86.90A, 86.90D, 86.90.E, 91.02, 91.03, 91.04, 93.29.Z.

ceuticals, medicines and other pharmaceutical products amounted to PLN 251.8 million, which ranks the Province 6th in Poland.

Drugs are also one of the most important export products of Podkarpackie Region. The value of export of these articles138 in 2019 amounted to PLN 530.8 million. At the same time, it is 81.9% higher than in 2013. Medicines are also the third most frequently exported group of goods to Ukraine.

Both the area of tourism and health in the Podkarpackie Province are not key branches of the economy for the development of the region (in comparison with aviation or automotive), however, their further strengthening (especially tourism) is important for a balanced economic growth of Podkarpackie Region. These industries have a great potential to use regional endogenous resources, they also demonstrate the ability to network cooperation, and with well-targeted support there is also a chance to increase their competitiveness. Therefore, they will constitute important areas of this specialisation in the remodelled system.

Quality of Life specialisation is distinguished from other specialisations not only by an extended scope, but also by the number of clusters active in the areas covered by this SS. Their main task is to network the cooperation of entities interested in the development of individual industries. Some of them are very active, while in the case of other clusters their functioning is limited or suspended due to the lack of financial resources for conducting business. Some clusters operating in the field of energy are located in the Podkarpackie Region, what includes:

- Subcarpathian Renewable Energy Cluster (PKEO);
- Southern Podkarpackie Region Energy Cluster;
- Solina Energy Cluster;
- Rzeszów Renewable Energy Cluster;
- Environmental and Energy Initiative Cluster (KISE).

The Podkarpackie Renewable Energy Cluster brings together various stakeholder groups. The aims of the project include ensuring a uniform representation of both entrepreneurs, investors, research entities and other entities that are involved in the development of renewable energy sources. The cluster is a place of cooperation of representatives of the renewable energy industry, it also enables the promotion of universities and member companies on both domestic and international market.

The remaining indicated energy clusters consists predominantly of local producers operating in the field of distributed energy, including prosumer energy, in their structures. Some of their goals include development of this type of energy, as well as obtaining lower energy costs.

Several tourism clusters can also be identified in the region. These include:

- Carpathian Tourist Cluster;
- Cluster 'Land of Podkarpackie Region';
- Przemyśl Tourist Cluster.

138 Medicines (excluding the products from pos. 3002, 3005 or 3006) composed of mixed or unmixed material products for prophylactic or therapeutical purposes, in packaging for retail sale, comp. *Handel zagraniczny*…, op. cit., p. 36.

Their main goal is to promote Podkarpackie Province as a region attractive for tourists, having high--quality tourism products. It should be noted that their activity is not limited to the area of tourism, but often also includes the area of health or organic food.

In addition to the above, there are clusters in the region that fit into the area of Quality of Life and related to food production:

- 'Podkarpackie Smaki' Cluster;
- 'Valley of Ecological Food' Cluster;
- Podkarpackie Organic Food Cluster;
- Podkarpackie Agricultural and Food Cluster.

Their activity is often not limited to the area of organic food production. They shall also take measures to promote regional products.

In addition, there are two medical clusters in the region: Technomed – Technology in Medicine and the Podkarpackie Health and Prevention Cluster established in 2020.

The barriers to the development of clusters of this specialisation include, among others, lack of understanding of the idea of clustering among entrepreneurs, lack of sufficient funding for the operational activities of the cluster coordinator, dependence on public funds or poor cooperation between entrepreneurs and research units.

Quality of Life specialisation has the most extensive and at the same time the least specified scope of all smart specialisations of the region. This was one of the reasons for the difficulties in matching support instruments for this specialisation. There were no natural links between its areas that could have allowed closer cooperation between entities representing different industries. This also made it difficult to identify an entity or cluster that would represent stakeholders in all areas of specialisation. Therefore, the Quality of Life required the introduction of modifications and clarification of the directions of support for the development of this specialisation under the RIS of the Podkarpackie Province.

3.4 The entrepreneurial discovery process in 2014-2020

If the process of identification of regional smart specialisations is to yield correct results, it is necessary to implement the entrepreneurial discovery process (EDP), which makes the prepared strategies more bottom-up. The process is defined as 'an interactive process in which market forces, in combination with the private sector, produce and provide information on new activities that are subsequently subject to assessment by the public authorities. As a result, the position of entities showing the greatest potential in terms of using the identified (discovered) potential is supported and strengthened'[139]. The aim of this process is to identify new areas of economic activity (not sec-

[139] Ibidem.

tors or industries) for the proper use of market and technological opportunities and to build a competitive advantage at the regional level[140].

In the Podkarpackie Province, EDP has for many years been a process involving the business and science sector, business environment institutions, non-governmental organizations, local and central administration bodies and the broadly understood society. Its implementation was financed as a part of the project *Smart specialisations – a tool for increasing the innovation and competitiveness of the Podkarpackie Province* introduced by the Local Government of Region. The entity implementing the project, which is also the coordinator of EDP operation in Podkarpackie Province, was the Department of Regional Development. It was the organizer of a number of events constituting a space for the exchange of knowledge and experience related to the functioning of the broadly understood innovation system in the region and the development of smart specialisations. This department was also responsible for the coordination of tasks related to monitoring and evaluation of the implementation of the RIS of the Podkarpackie Province, and together with the Podkarpackie Innovation Council also supervised the implementation of activities related to supplying the EDP with the necessary knowledge.

EDP was conducted primarily as part of the Smart Specialisations Panels, which were created in accordance with the provisions of the Regional Innovation Strategy of the Podkarpackie Province, as a continuation of the entrepreneurial discovery within the already existing SSs. Their participants were stakeholders of individual specialisations, representing all sectors involved in the implementation of the innovation system. External experts, representing various fields of knowledge, dealing (both in practice and through scientific activity) with topics related to smart specialisations of the Podkarpackie Region, were often invited to participate. The panels were systematic, creative meetings, during which exchange of knowledge, experience, development of common solutions and projects took place.

As part of the panels dedicated to the Aviation and Cosmonautics specialisation, a letter of intent was signed to create a design company that would be involved in the a serial production of a light aircraft with a take-off weight of up to 7 tons. The issues discussed during the panels included also such topics as the organization of competitions within the Clean Sky 2 programme, as part of which Podkarpackie companies began the implementation of aviation projects. Panel stakeholders also discussed issues related to the innovation management system in the region or bottlenecks in the field of innovation diffusion caused by e.g., the dispersion of funding or the systemic barriers hindering the cooperation between business and science.

One of the results of the EDP carried out within the panels was the identification of the Automotive Industry as the fourth regional specialisation and, consequently, the update of RIS3. Implemented automotive panels also allowed to create flashcards and concepts of partner projects. Such initiatives included, among others, a mobile measurement laboratory for vocational schools or an online platform for the exchange of offers and orders based on the model of a 'Podkarpackie Region automobile'. Participation in the panels also expanded the knowledge of stakeholders in the areas related

[140] Czyżewska D., Godlewska A., *Doświadczenia wybranych polskich regionów w rozpoznaniu i wdrażaniu inteligentnych specjalizacji*, Studia i Prace Wydziału Nauk Ekonomicznych i Zarządzania 2014, No. 37, Vol. 2, pp. 209-220.

to the development of the automotive industry and the possibilities of obtaining EU funding for the implementation of projects, including successful initiatives such as Think Tank East Automotive Alliance, EU DRIVES, EACN, PAMISZ or COSME.

Panels related to the ICT smart specialziation, in addition to serving as networking meetings with representatives of other industries, also allowed for the development of flashcards of 4 cooperation networking projects for which it was planned to obtain funding under the ROP PP 2014-2020.

During the Quality of Life smart specialisation panels, the stakeholders of the specialisation discussed, among others, the key directions of development of individual areas of specialisation. As a result of the meetings, 6 projects submitted for co-financing under the ROP PP 2014-2020 were identified.

Another element of EDP is SS Metapanels , which are a space for discussion and exchange of experience between the stakeholders of all regional specialisations. Their goal was to expand cooperation within various initiatives and projects, not only in the area of individual specialisations, but also between different SSs. The first two-day Metapanel was conducted in 2019.

In 2017-2020, 25 panels and 1 metapanel were conducted.

An important component of the entrepreneurial discovery process carried out in the region were the meetings of the Podkarpackie Innovation Council (PIC), consisting of representatives of business, science, administration and society. The Council was an advisory and opinionating body of the Podkarpackie Region Board in the field of development, implementation and realization of the Regional Innovation Strategy. Its has been involved in EDPs since 2012, when the RIS3 strategy was being prepared. Members of the PIC actively participated in the implementation of the research conducted within the framework of the *Strengthening the institutional system of implementation of the Regional Innovation Strategy in 2005-2013 in the Podkarpackie Province* system project.

During the PIC meetings, issues related to the identification of regional smart specialisations, division of tasks and competences among the stakeholders of the innovation system were discussed, and the priority activities in the field of cooperation of the science and business were indicated. The operational model of the Innovation Strategy and its projects was also presented. The subject matter of the meetings also included discussions on the ROP PP 2014-2020, which was the most important source of financing for activities related to the development of smart specialisations. The Council also indicated the most important directions for supporting innovative activities from the point of view of economic development.

An important role in EDPs, especially in the process of selecting regional smart specialisations, was played by the Podkarpackie Innovation Forums (PIFs), which are regional and supra-regional meetings in the form of conferences, workshops or seminars aimed at collecting and transferring knowledge about the region's innovation. The Forums were attended by stakeholders representing various entities forming the regional innovation system. The PIF implementation initiative was launched in 2003-2004. Regularly organized Forums were elements of the implementation of the first Regional Innovation Strategy of the Podkarpackie Province. During the preparation of RIS3, PIFs developed solutions to support the innovation in the 2014-2020 programming period. In the recent years, the Forums took form of a conference identifying the most important trends that could play an important role in the development of specialisations. As a result, PIFs brought together experts from

around the world, whose activities were related to areas identified as smart specialisations of the region. Thanks to the diversity of panelists and participants of the Forums, both scientists and practitioners, it was possible to exchange knowledge and experience and present good practices from the implementation of innovative solutions.

EDP was also carried out as part of the work on the preparation of the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030*. In addition to the PIC meetings and the implementation of the Smart Specialisation Panels, regional experts from the scientific, business and cluster communities actively participated in the work related to the development of the RIS of the Podkarpackie Province. Thanks to this cooperation, it was possible to verify the validity of the initially adopted directions of support for individual specialisations, as well as to identify technologies that will be crucial for the development of SS. The proposals prepared by the experts were then discussed with a wider range of specialisation stakeholders. Prior to the adoption of the final version of the Strategy by the Podkarpackie Region Board, a public consultation process of this document was conducted among a wide range of stakeholders of the innovation system, representing all sectors involved in the implementation of the RIS of the Podkarpackie Province.

3.5 The bottlenecks of diffusion of innovation and digitisation

The bottlenecks are defined as the entities or processes (or elements of these processes) nagatively affecting the efficiency of the system as a whole. The bottlenecks of innovation diffusion are barriers that hinder the functioning of individual elements of the innovation system, as well as those that negatively affect the relationships between the elements of the system.

The emerging barriers in the implementation and dissemination of innovations are one of the issues that were frequently analyzed since the update of the first innovation strategy in the Podkarpackie Province[141]. They were also one of the subjects of analysis in the World Bank's report *Designing regional technology transfer office: Podkarpackie Centre for Innovation*, created as a part of the *Catching-up Regions 2* initiative[142]. The spread of innovation is also discussed, among others, in the RIS3 monitoring reports.

The bottlenecks of innovation diffusion have mostly been identified and described within the report titled *The innovation system in the Podkarpackie Province* based on the analysis of data, completed telephone interviews and conclusions from the expert panel[143]. These include barriers related to:

- The system of functioning of universities in the context of the third mission
- Translating strategy papers into support instruments;
- Restrictions on access to measures to support innovation;

[141] *Aktualizacja Regionalnej Strategii Innowacji Województwa Podkarpackiego na lata 2005-2013*, Rzeszów 2011, pp. 30-31, 42-43.

[142] *Tworzenie regionalnego centrum transferu technologii: Podkarpackie Centrum Innowacji*, World Bank, 2017, pp. 17-18, 20-21.

[143] *System innowacji*…, op. cit., pp. 80-87.

- Emerging human capital deficits;
- Low propensity to innovate in the SME sector;
- Difficulties in institutional cooperation and implementation of network projects;
- Necessary competition between the services supporting the innovation;
- Difficulties in digital diffusion.

The above-mentioned bottlenecks are synthetically described in the following subsections.

3.5.1 The system of functioning of universities in the context of the third mission

Research units, in addition to carrying out tasks related to education and conducting scientific research, should also engage in the establishing and deepening cooperation with its surroundings. This is the so-called 'third mission of the university' that allows it to become an important factor in the development of the region. The emergence of a bottleneck in the fulfillment of the third mission by the universities in Podkarpackie is related to the system of functioning of higher education.

The current system of the scientific work evaluation was strictly focused on didactics and the system of evaluation of the researcher focused on the scientific articles/studies published by them. So far, no attention has been paid to the degree of employee involvement in cooperation with the university environment. This approach is gradually changing, making it possible to increase the interest in undertaking such cooperation by university researchers.

The financial system also does not encourage increased involvement of researchers in the implementation of the third mission of the university. The implementation of research projects commissioned at universities is associated with the need for relatively high financial outlays, as well as the need to conclude additional contracts with the university. A much cheaper solution for business is to conclude a contract directly with a scientist, who will be responsible for the implementation of the research project without the intermediation of the university.

Another, and at the same time one of the most important factors responsible for diffusion problems of innovation is a different style of work presented by representatives of the science and business sector. The research work carried out sometimes requires a broad time frame in order to see the effects of their implementation what contradicts the expectations of entrepreneurs to obtain the results of research as soon as possible. In addition, the time required to conducting research works is often extended by the bureaucratic burdens, as well as the need to divide the working time of the researcher between all three missions of their alma mater.

Recognising the importance of this barrier, the WIPO has adopted the development and strengthening of the regional innovation system as one of its strategic objectives. This is to be achieved by supporting the development of cooperation between the key players in the system, including the support for the process of strengthening cooperation between research institutions and the business sector. The Podkarpackie Centre for Innovation acts as a kind of intermediary between these two sectors and its tasks include facilitating effective cooperation between science and business. However, it should be borne in mind that it is not possible to eliminate the bottlenecks of the diffusion of innovations related to the functioning of universities and research and scientific units

or to counteract their effects in a relatively short period of time. This requires changes in the rules of functioning of the university, which will regulate issues related to, among others, the involvement of scientific employees in undertaking cooperation with the environment, or establishing direct cooperation with business without the parent scientific unit.

3.5.2 Translating strategy papers into support instruments

The indicated bottleneck concerns the difficulties in translating the provisions of strategic documents into implementation documents, e.g. Axis I of the Regional Operational Programme of the Podkarpackie Province for the years 2014-2020 *Competitive and innovative economy*, which sometimes resulted in restrictions on access to financial resources for specialisation stakeholders.

Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020, adopted in 2015, contained a rather imprecise description of the specialisation, especially in the field of Quality of Life SS. Descriptive presentation of the area of specialisation in made it impossible to clearly determine its scope. This in turn complicate the design and implementation of support instruments for regional smart specialisations. The issues with the assignment to appropriate specialisations were also identified at the stage of project evaluation as part of individual calls for the co-financing applications. Therefore, in 2016, the RIS 3 Strategy was updated and Action Plans for individual specialisations were prepared, clarifying their scopes. The adoption of these documents slightly reduced the scale of the difficulties but did not eliminate them completely. Some of the applicants applying for funding after the adoption of the Action Plans no longer fell within the scope of the SS.

Thanks to the involvement of representatives of the Marshal Office of the Podkarpackie Province departments responsible for the preparation and implementation of the European Funds for the Podkarpackie Region 2021-2027 in the work of the Working Group on the Development of the Innovation Strategy, RIS of the Podkarpackie Province should reduce or completely eliminate discrepancies between the strategic document and the provisions of the operational programme.

In addition, the Monitoring Committee of the Regional Operational Programme includes stakeholders of smart specialisations of the region (this will also apply to the next financial perspective). They have the opportunity to participate in decisions regarding the provisions of the Regional Operational Programme. The same groups of stakeholders (although in the case of scientific units and entrepreneurs represented by other representatives) are part of the Podkarpackie Innovation Council, which is an advisory and advisory body of the Podkarpackie Region Board in matters related to the development and implementation of the Regional Innovation Strategy and thus have an impact on the provisions of the strategic document. However, special attention will be paid to the wider transmission of the findings made during the meetings of the Podkarpackie Innovation Council to all stakeholder groups.

3.5.3 Restrictions on access to measures to support innovation

Barriers in the diffusion of innovation related to restrictions on access to measures supporting innovation concern the effects of interventions undertaken, mainly within the framework of the ROP of the Podkarpackie Province.

One of the factors responsible for the occurrence of barriers in the diffusion of innovation was the difficulties associated with obtaining EU funding in the 2014-2020 financial perspective for conducting activities by clusters. Clusters are often organisations set up to enable the transfer of knowledge and technology between its members, and are thus an important element of the process of diffusion of innovation. Problems with obtaining co-financing for activities the operation of clusters with EU funds sometimes resulted in the suspension or dissolution of the cluster. In the financial perspective 2021-2027, it is planned to restore the possibility of obtaining support for the activities of clusters. Therefore, there is a chance for the emergence of new or reactivated suspended cluster initiatives, as well as for the strengthening the activities of already functioning clusters.

Another element of the bottleneck related to limiting access to funds for the development of innovation is the systemic difficulty of supporting the implementation of projects. The implementation of innovative solutions is divided into 9 levels of technological readiness, which often results in a long time of research carried out for the needs of many industries, including aviation. To a lesser extent, this applies to process innovations (in the aviation industry, these are mainly technologies). However, it is a key constraint in terms of product innovation. This is due to the specificity of the aviation industry, characterized by the long time required to transition from the research phase to the implementation of the product on the market and the high capital intensity of this process. Therefore, there is a structural inconsistency of this process with the support rules, where it is expected that the project settlement (with the implementation time usually not exceeding three years) is to be the product implemented for production. However, these restrictions result from the regulations concerning the use of regional funds established by the European Commission, which are not affected by the Managing Authorities of the Operational Programmes. Considering that product innovation is the main carrier of innovation in the long term, it is necessary for the aviation industry to take organisational measures that provide opportunities to circumvent this limitation. Its elimination is crucial in order to avoid the aviation industry in the Podkarpackie Region being a victim to a medium development trap.

The last factor influencing the identification of this issue as a bottleneck of the diffusion of innovation are funds for the implementation of targeted research. The scientific community positively assesses the possibility of obtaining grants, but on the other hand, it raises the need to increase its impact on the shape of the rules for granting grants. A way to reduce the scale of this problem is the functioning of the PIC Resource Allocation Committee, which is a collegial body including, among others, representatives of Podkarpackie universities. Its tasks include supervision over the course of cooperation between PIC and the company's partners, including in the scope of the grant programme implemented by this entity[144].

3.5.4 Emerging human capital deficits

One of the main barriers to the diffusion of innovations related to human capital is the insufficient availability of qualified staff, responding to the needs of employers, including people with qualifications and competences to design and implement innovative solutions. This may involve insufficient

[144] https://pcinn.org/aktualnosci-pci/399 [access 26.05.2021].

opportunities to acquire practical knowledge. It is important to establish and strengthen the already existing cooperation between entrepreneurs and universities or vocational schools in order to adapt the courses and programmes of education to the requirements of the labour market. In the region, such cooperation is already being undertaken in the form of e.g., a system of patronage classes, or as part of the PAMISZ project, described in chapter 3.3.2. An important role in this respect will be played by the Voivodship Labor Office in Rzeszów as an Intermediate Body in the distribution of funds for purposes related to, among others, human resources training. It is also a unit that produces many valuable analyses concerning the labour market, including the needs reported by employers in the area of competences and qualifications of potential employees.

RIS of the Podkarpackie Province will support activities undertaken to establish and strengthen co-operation between the education and business sectors by identifying as one of the objectives of the strategy the need to adapt the education system to the needs of the labour market.

3.5.5 Low propensity to innovate in the SME sector

Another factor, also related to human capital, is the lack of awareness of the inhabitants of the Province regarding the importance of innovation for the economic development of the region. This applies to some entrepreneurs, especially those representing the SME sector, as well as representatives of the wider society. Innovations for small companies mostly mean the effective use of knowledge and technologies already on the market through, for example, the purchase and implementation of a new production line, which was successfully implemented earlier by a competitive company.

Such a passive attitude towards innovation may result from ignorance of trends in new technologies or the development of policies focused on e.g., environmental issues. While these conditions are accepted by small companies in relation to process innovation (the implementation of a production technology already existing on the market directly translates to increased competitiveness), in relation to product innovation, for example for SMEs in the aviation sector, they currently constitute an insurmountable barrier. Often, the introduction of innovation entails the need to take action related to patent procedures. This is an additional disincentive to innovation.

Clusters and networks of partnerships play an important role in the diffusion of innovation in enterprises, which facilitate the exchange of knowledge and experience also in the field of innovation. Business environment institutions (BEIs) play an important role in the process of diffusion of innovations and their dissemination. A similar task will also be carried out by the Podkarpackie Science Center 'Łukasiewicz', created by the initiative of the Local Government of Podkarpackie Region. BEIs should raise awareness of the fact that SMEs ned to increase their position in the value chain of products and to provide organisational support for the activities enabling the implementation of this project.

RIS of the Podkarpackie Province in its activities will support both the implementation of goals related to the development of innovation, as well as activities aimed at increasing the competitiveness of companies, especially in sectors where there are not many opportunities to develop and implement innovative solutions in the strict sense of the term.

3.5.6 Difficulties in institutional cooperation and implementation of network projects

The bottleneck concerning institutional cooperation mainly concerns the lack or insufficient level of cooperation between business environment institutions. This may result from competition between EBIs for a place in the system or attempts to obtain the maximum amount of resources possible. This prevents the creation of a complementary services system and, consequently, limits the access of entrepreneurs to the services offered by EBIs. Therefore, the course of work on RIS of the Podkarpackie Province, included the development of a matrix of tasks carried out by the stakeholders of the innovation system, representing all elements of the quadruple helix, what in turned allowed the identification of activities aimed at e.g., diffusing innovation and which are not developed by any element of the system. This matrix should also make it easier for business environment institutions to identify potential partners to create a network of partnerships that would ensure complementarity of services provided, thus enabling smoother implementation of innovations.

Another aspect that contributes to the identification of a barrier in this respect is the insufficient scope of cooperation undertaken by stakeholders in the field of Quality of Life. The areas constituting this SS do not currently have sufficient potential to become independent specialisations. On the other hand, these are areas that have many common features and thus are able to implement network projects involving entities representing the same area specialisation, as well as stakeholders representing various sectors of the economy, such as tourism cuisine routes, or the implementation of ICT solutions in tourism. However, this requires strengthening cooperation between administration and business, as well as the cooperation between local governments.

An important factor of this bottleneck is also the durability of the established cooperation, which often does not have the character of a stable relationship. This is often due to the impossibility of further financing of joint activities, but also to the lack of horizontal strategies that would enable the institution to build its capacity on the basis of cooperation. There is a need to intensify cooperation activities in the field of participation in economic missions, fairs, including foreign ones, where part of the costs associated with participation in such events would be covered by local governments.

RIS of the Podkarpackie Province assumes support for actions strengthening cooperation between individual elements of the helix. In addition, each of the sectors mentioned was included in the public consultation process of the innovation strategy project. The development and implementation of joint projects is also possible through SS Panels, which provide a forum for the exchange of knowledge and experience between the stakeholders of individual specialisations.

3.5.7 Necessary competition between the services supporting the innovation

The Local Government of Podkarpackie Province striving to initiate activities aimed at supporting the development of the region's innovation, often encounters certain limitations related to the support of the development of innovation at the national and European level. In such cases, the offer of the Local Government of Region must compete with the offer of the central administra-

tion. This situation occurs, for example, in the case of the Podkarpackie Business Support Platform project, implemented by the Marshal Office of the Podkarpackie Province in cooperation with the University of Information Technology and Management, for which the Development Services Database run by the Polish Agency of Enterprise Development is a competitor. The presence of a large, nationwide database with similar functionality has a very strong impact on the decline of interest in the regional base.

In order to prevent the occurrence of such barriers, it is necessary to search for appropriate niches and fields of support that were not developed by other entities but at the same time correspond with the needs reported by entities seeking support. Therefore, it is necessary to strengthen cooperation between the stakeholders of the innovation system, enabling accurate identification of the needs for the necessary support for innovative activities. This will be supported, among others, by the implementation of EDPs, including Smart Specialisation Panels, PIC meetings, as well as meetings of high-opportunity industry stakeholders.

It also seems necessary to seek complementarity with other forms of innovation support. Such a change in the approach to the use of innovation funds can contribute to overcoming of the existing organisational and financial barriers.

3.5.8 Difficulties in digital diffusion

Digitisation plays an increasingly important role in almost every area of socio-economic development. Experiences related to the COVID-19 pandemic, as well as the ongoing industrial revolution, indicate that its importance may be even greater in the future. This is also recognised by the European Commission, which emphasises the need to accelerate technological transformation, including the development of digital solutions and cybersecurity[145]. As already indicated in the diagnostic part, the Podkarpackie Province has an extensive telecommunications infrastructure, although the level of implementation of digital solutions in the region is relatively low. This applies to both companies (some companies do not even have their own website) and to administration that uses digital technologies to a small extent, for example to conduct electronic documentation management. This is often due to the high cost of implementing comprehensive digital solutions, as well as the lack of appropriate staff responsible for their implementation and subsequent management[146].

The Local Government of Podkarpackie Region has for years recognized the importance of information and telecommunications technologies, which is why ICT has been indicated as one of the smart specialisations of the region. In addition to identifying this specialisation as one of the pillars of the region's socio-economic development, the WFD also identifies activities aimed at promoting the use of information and communication technologies in both the business and administration sectors.

145 https://www.consilium.europa.eu/pl/policies/a-digital-future-for-europe/ [access 26.05.2021].
146 *Efekty wsparcia zastosowań TIK…*, op. cit., pp. 43-46.

4 SWOT Analysis

SWOT analysis (Strengths-Weaknessess-Opportunities-Threats) is one of the tools used as part of the strategic analysis. Using the diagnosis carried out and synthetically described in Chapter 3, and the experience from the implementation and implementation of previous strategies, the analysis allowed to identify areas that constitute strengths and weaknesses related to the region's economy, as well as the opportunities and threats to its further development. The analysis representing this division is presented in the table below.

Table 5. SWOT analysis

Strengths	Weaknesses
• High dynamics of GDP growth. • Growing number of entities with foreign capital per 10 thousand inhabitants. • Possibility of investing in existing economic zones, technology parks and business incubators. • High industrialisation of the region. • Increase in the region's innovativeness according to the *Regional Innovation Scoreboard*. • Innovative potential exceeding strength of the economy of the region as measured by the share of GDP. • High share of enterprises industrial companies incurring expenditures on innovative activities. • A high percentage of R&D expenditure in enterprises in relation to GDP. • High percentage of enterprises innovation-active industries. • High share of industrial enterprises cooperating within innovative activity. • Growing share of the service enterprises cooperating in the course of their innovative activity. • Developed structure of the regional system of innovation, including numerous and diverse Institutions from the business environment. • High dynamics of growth of a number of inventions reported in the Patent Office. • R&D potential of the Podkarpackie universities and the private sector. • High position of Rzeszów University of Technology in the ranking of Universities in terms of innovation. • High position of WSIiZ in the ranking of schools in terms of internationalization.	• Low level of total and per capita GDP. • Low level of entrepreneurship against the background of the country. • One of the highest unemployment rates in the country. • One of the lowest monthly gross salaries in the country. • Unequal rate of development of individual subregions within the province. • Poor investment attractiveness according to the PAIH ranking. • High share of people working in agriculture in the structure of those working in the national economy. • Dominance of the entities conducting service activities. • A negligible number of spin-off companies. • Economic downtime in many industries caused by the COVID-19 pandemic. • Low level of innovation in the SME sector. • Low level of willingness to cooperate between enterprises. • Insufficient level of cross-sectoral cooperation of the stakeholders in the field of Quality of Life. • Financing dominance of the innovative undertakings from own resources. • Low number of applications to the Patent's Office and awarded patents. • The lowest number of the business environment institutions per 10 thousand entities of the national economy in the country. • Insufficient level of commercialisation of research conducted at universities.

Strengths	Weaknesses
• Extensive education system at faculties related to smart specialisations. • High concentration of sector of aviation, automotive and IT. • Developed automotive and cosmonautics industry, with long traditions and foreign capital involved. • A high percentage of enterprises with Internet access. • High percentage of households with Internet connection and access. • High percentage of entities using the system of Electronic Document Management. • Natural and Cultural Landscape with outstanding aesthetic qualities affecting the tourist attractiveness of the region, • Presence of natural therapeutic values and health resort treatment based on them, • Potential for production development of pharmaceuticals and dietary supplements, • Increasing exports of medicines, • Very good conditions for the development of technology using renewable energy sources (solar, wind and, to some extent, hydroelectric power), • Favourable environmental conditions for development of organic farming and sustainable and natural tourism, including health resorts, • Well-developed agriculture and processing environmentally friendly • The growing importance of food and food products in export, • Increase in the production of high-quality food, including ecological and traditional products • Location close to country border and communications infrastructure • Good communication with Małopolska, Silesia, Opolskie and Lower Silesia Provinces enabling the strengthening of cooperation between companies from the southern Poland and the prospect of good communication within the Eastern Poland Macroregion.	• Low position of Podkarpackie universities in of the general classification in the Higher Education Ranking Prospects 2020. • Competency gap between demand on the market and people jobseekers. • Low level of digital technology utilization in business activities and production one. • Insufficient level of implementation solutions in the field of Industry 4.0 and circular economy. • Low awareness of entrepreneurs in the scope of circular economy solutions. • Low percentage of companies possessing their own website. • A small number of branded, highly standard tourist products and insufficiently developed tourist infrastructure.

Opportunities	Threats
• Possibility of establishing cross-border cooperative links in the value chain, • Development of research, emergence of new technology and increased public awareness in the area of environment, energetics and sustainability goals, • Development of economic links in the north-south system through the implementation of the Via Carpatia route, • Improving transport accessibility of the region, • Access to external funds (including EU funds resulting from the implementation of cohesion policy), • Support policy by the European Commission for weaker regions, • Concentration of European funds on activities related to reducing the human impact on the natural environment, • National Recovery Plan, • National policy compliant with the Strategy for Responsible Development, creating preferences in relation to medium-sized cities losing their socio-economic functions, • Accelerating Digital Transformation caused by COVID-19, • Development of e-services based on digital resources, • Rates of adverse demographic changes lower than the country averages; • Trends related to high quality of life and an increase in interest in organic food, • Increasing public awareness of the importance of an active, health-promoting lifestyle, • The growing importance of alternative sources of electricity, • Moving away from a linear model of the economy to for the implementation of the circular economy.	• Easy transfer of entire sectors to countries with more accessible resources or lower costs, • Economic development of China and other Asian countries (competitiveness in the introduction of innovative products), • Increasing competition of regions in the sphere of innovation, • Decrease in the share of net revenues from sales of innovative products in total sales revenues; • Very strong impact of the related crisis with the pandemic on most of the industries that fit into the smart specialisations of the region, including primarily aviation and tourism-related industries, High sensitivity of the tourism sector to changes in the economic situation, • Rising production costs resulting from environmental regulations, • Changes of the climate resulting in anomalies in weather as well as limitations in resources of water, raw minerals and energy, • Unfavourable demographic processes affecting the labour market, • Outflow of young, active and highly professional workers, • A systematic decrease in the number of students, also in the in the field of information technology, • Low salaries in the scientific sector in Poland.

Source: own study

Quantitative analysis of the factors identified in the table above indicates dominance of the areas identified as strengths of the regional economy. There is also a visible predominance of factors defined as opportunities over threats to the further development of Podkarpackie Region. This is a confirmation of the correctness of the policy directions of the Local Government of Region adopted so far in terms of strengthening the regional economy, the continuation of which will be RIS of the Podkarpackie Province.

5 Smart specialisations of Podkarpackie Region

At the heart of the concept of smart specialisation is the assumption that none of the regions of the European Union cannot achieve a competitive advantage in all fields in terms of science, technology and innovation. It is therefore necessary to indicate a limited list of areas in which the region has the potential to build a primacy. The implementation of the concept makes it possible to increase the effectiveness of public intervention and to be able to gain a competitive advantage in any region, even those specialising in traditional fields[147]. However, the separation of specialisation is not an end in itself, but one of the tools that have the objective of economic development of the region through the use of its resources.

The condition for indicating a given area as a smart specialisation is to meet a number of criteria. For the purpose of identifying specialisations at national level, the following conditions have been adopted:

- Occurrence of R&D potential;
- Level of economic specialisation;
- Occurrence of cooperative relations;
- Competitive position;
- Potential to develop solutions to key societal challenges[148].

Identification of smart specialisations of the Podkarpackie Province is a process implemented using an expert-participatory model, lasting for many years. Specialisations were not indicated from above by the Local Government of Region – the proces of their identification was conducted with the cooperation of different groups of interested parties including entrepreneurs and scientists. The first regional strategy of innovation (RSI) was developed by the Podkarpackie Province as a result between 2003-2004 of the target project entitled "Regional Innovation Strategy for the Podkarpackie Province" co-financed by the Ministry of Science and Informatization. The Local Parliament of Podkarpackie Region adopted the *Regional Innovation Strategy of the Podkarpackie Province for 2005-2013* in 2004 by Resolution No. XXXIII/369/04 of 30 December 2004.

147 Pilarska Cz., *Koncepcja smart specialisation w polityce ekonomicznej Unii Europejskiej*, Studia Europejskie 2014, No. 4, pp. 59-81.

148 https://www.smart.gov.pl/pl/co-to-jest-inteligentna-specjalizacja/jak-wylaniane-sa-inteligentne-specjalizacje [access 26.05.2021].

During the conceptual work and editing of the RSI document for 2014-2020, its co-creators participated in meetings, seminars, workshops, conferences, working groups, the aim of which was to understand the essence and develop the most accurate strategy of smart specialisation. Six criteria have also been established to identify specialisations at regional level:

1. Proven current and prospective potential for smart specialisation, current and future relevance for the region.
2. The level of development of smart specialisation compared to the leading regions of Poland and European Union.
3. The opportunity to demonstrate the close relationship between smart specialisation and the research and development potential of the region.
4. Existing endogenous resources, which avoids some forms of dependency and copying.
5. The presence or prospect of developing strong clusters in areas of smart specialisation.
6. Possibility of development and using directives and regulations of the path of economic and legal support by the European Union.

After analyzing the advantages of the region and its endogenous resources, economic traditions, the potential of industries, including in the field of research and scientific activities, as well as networking cooperation in 2015, *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020* indicated three smart specialisations of the region: Aviation and Cosmonautics, Quality of Life and Information and Telecommunications.

Identifying a specialisation is not a one-time activity. Due to the procedural nature of their identification, as well as due to the dynamic changes taking place in the enterprise sector, the Local Government of Region constantly monitors the economic development of Podkarpackie Region. The data collected in this way allow to assess the potential of individual industries that have a significant impact on the broadly understood development of the region, and may also constitute its important pillars in the future, and thus become further regional specialisations.

An important element of the identification of specialisation is also the implementation of the entrepreneurial discovery process (EDP). As a result of the EDP conducted in the region, after the analysis of the innovation potential and the competitiveness of the sector, the Automotive specialisation has been included in the Podkarpackie Region SS catalog. The identification of SS within RIS of the Podkarpackie Province is a continuation of this process.

Previous experience from the implementation of the innovation strategy, as well as expert analyses confirm the indications as specialisation of Aviation and Cosmonautics, Automotive and ICT, which is why in RIS of the Podkarpackie Province will be subjected only to cosmetic modifications. At the same time, a very wide range of entities and areas that fit into the Quality of Life[149]. An attempt to narrow it down took place only at the stage of developing the Action Plan for specialisation in 2016. However, difficulties persisted in the design and implementation of support instruments for this specialisation. Therefore, RIS of the Podkarpackie Province makes the necessary adjustments and modifications within the Quality of Life SS. In addition, the division into leading and supporting spe-

[149] Com. *System innowacji*…, pp. 80-81, *Monitoring*…, p. 57.

cialisations has been abolished. In addition, due to the lack of availability of statistical data to compare the development of smart specialisations, especially in other REGIONS OF THE EU, the wording of one of the criteria for identifying specialisations at regional level has been changed. The criterion "the level of development of smart specialisation compared to the leading regions of the Polish and the European Union" was replaced by the following: "the level of development of the Podkarpackie Province against the background of Polish and EU regions with the same or similar specialisation".

Regional Innovation Strategy of the Podkarpackie Province for 2021-2030 was created during the period of designing operational programmes, which are the main source of financing for activities recorded in strategic documents, including those contained in the RIS of the Podkarpackie Province. Therefore, the identification of specialisations presented in the following subsections, especially the definition of their scopes, takes into account both the conclusions drawn from the implementation of previous strategies innovation, as well as experience resulting from the implementation of the ROP PP, primarily in the area of Improvement of competitiveness and innovativeness of enterprises.

It is difficult to precisely determine the scope of individual specialisations using codes of PCA (Polish Classification of Activities), and thus effectively monitor their development. This is mainly due to the inability to assign departments or even PCA classes to each of the specialisations. Many times particular classes of PCA match the scope of two or more specialisations or may match given SS only partially. It should also be borne in mind that statistical data allowing to assess the development of the industry in the province are usually available only at the level of departments and not PCA classes. Therefore, an expert estimate will be made in terms of the percentage of matching particular departments of regional smart specialisations. These sections have been indicated at a description of the areas of each specialisation.

The description of specialisations, their scope and areas of support, as well as the directions of activities, were prepared as part of the work on RIS of the Podkarpackie Province in cooperation with an expert supervising the substantive course of their course. An important contribution to the shape of the directional part of the strategy was also made by experts representing individual industries forming SS, as well as participants of the SS Panels who helped to indicate technologies that are or will be crucial for the development of individual specialisations.

The tables in the following subsections indicate that individual regional specialisations meet the criteria adopted for the identification of SS.

5.1 Aviation and Cosmonautics smart specialisation

5.1.1 Identification and fulfilment of criteria SS

Table 6. Completion of regional criteria for the identification of specialisation by Aviation and Cosmonautics SS

1. Proven current and prospective potential for smart specialisation, as well as the current and future relevance to region	The choice of Aviation and Cosmonautics as a smart specialisation is predominantly justified by a high potential of the region: • Most of the Polish production in the aviation industry is concentrated in Podkarpackie Province; • Companies operating in the region participate in international supply chains, producing and providing components for the most important global aviation companies; • A branch of the Polish Space Agency is located in Rzeszów; • Podkarpackie Province is the leader of the regional consortium ESA BIC Poland; • Increasingly common implementation of solutions designed for the space industry in other areas of the economy; • Increase in the number of companies that fit into the specialisation in the years 2014-2018; • Positive dynamics of industry revenues in this period; • Systematic increase in average employment in SS entities[150]; • Technologies used in the cosmonautics industry have both civilian and military use; • Planned establishment of a modern aircraft maintenance base by LOTAMS (LOT Aircraft Mainte-nance Services).
2. The level of development of the Podkarpackie Province compared to the Polish and EU regions with the same or similar specialisation	• The Podkarpackie Province is the only one in Poland to adopt Aviation and Cosmonautics as a smart specialisation; • Comparison with other European regions specializing in aviation (i.e., Andalusia in Spain and Lom-bardy in Italy), in terms of a synthetic innovation index shows that the development of this industry in the Podkarpackie Province is at a similar level as in the Spanish region; • In comparison with the mentioned regions, Podkarpackie Province is distinguished by a higher percentage of the population aged 30-34 with tertiary education, expenditure on research and devel-opment in the sector of the enterprises as interest of GDP and share in expenses for innovations in SMEs relative to turnover rate of the latter[151].

[150] Comp. *Monitoring*…, op. cit., pp. 25, 48-50, *Wiodące branże*…, op. cit., pp. 11-17.

[151] Comp. *Monitoring*…, op. cit., p. 26. Due to the different levels of data collected by institutions responsible for the collection of statistical data in individual EU countries it is not possible to clearly compare the level of development of specialisation in different European regions. Therefore, in accordance with the RIS3 Moni-toring System of the Podkarpackie Province developed in 2018, the development of specialisation is assessed by comparing regions with similar SS using indicators utilized in the *Regional Innovation Scoreboard*. The remark above applies to all specialisations of Podkarpackie Province.

3. The possibility to show strict relation of smart specialisation with research and developmental potential of the regio	Specialisation Aviation and Cosmonautics has confirmed scientific and research potential: • Aviation and Cosmonautics are classified as high-tech sectors, they also affect the development of other branches of the economy; • The University of Technology has a wide range of technical facilities and scientific in the field of aviation, operates e.g., University Laboratory of Materials Research for the Aviation Industry, accredited by NADCAP (National Aerospace and Defense Contractors Accreditation Program); • In 2004 the 'AERONET – Aviation Valley' Center of Advanced Technologies was established as a joint initiative of the Universities of Technology in Rzeszów, Lublin, Łódź, Gliwice, Warszawa and Rzeszów, and the 'Aviation Valley' Association, conducting activities in the field of research, implementation and commercialization of solutions developed for the needs of the aviation sector. The Faculty of Mechanical Engineering and Aviation of the Rzeszów University of Technology conducts education in the field of Aviation and Cosmonautics, including the specialisation of Pilotage; • Education in fields related to specialisation (e.g., aircraft mechanic, avionics technician) is also offered in secondary schools.
4. Existing endogenous resources that prevent some forms of dependency and duplication	• Traditions of the aviation industry developed in Podkarpackie Province date back to the beginning of the twentieth century and the creation of the Central Industrial District; • Higher than national average concentration of entities compliant with the smart specialisation; • Active cooperation between business and science in the field of aviation and cosmonautics; • Presence of the Rzeszów-Jasionka international airport; • Transport accessibility provided by the A4 motorway and the S19 expressway.
5. Presence or prospect of developing strong clusters in smart specialisation areas	There are 2 clusters of international scope active in the region: • 'Aviation Valley' possessing the status of the National Key Cluster; • Podkarpackie Cooperative Association – Cluster of Lightweight and Ultralight Aviation • The Cluster of Unmanned Systems is also located in Podkarpackie Province. In addition, at the beginning of 2021, a letter of intent was signed on the creation of a cosmonautics cluster in the region.
6. The opportunity to grow and the use of directives and regulations defining economic paths and legal support by the European Union	• *Regulation of the European Parliament and of the Council (UE) 2018/1139 of 4 uly 2018 on joint rules in the field of civil aviation and the creation of a European Union Agency for Civil Aviation Aviation Safety and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 of the European Parliament and of the Council and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91*[152];

[152] *Regulation of the European Parliament and of the Council (UE) 2018/1139 of 4 July 2018 on joint rules in the field of civil aviation and the creation of a European Union Agency for Civil Aviation Aviation Safety and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 of the European Parliament and of the Council and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council and repealing Regulations (EC) No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91*, JoL EU 212 of 22.8.2018.

	• *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. European Strategy in the field of aviation*, with emphasis on the development of this sector of the economy as having a significant impact on economic growth, employment, trade and mobility[153]; • *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A New Industrial Strategy for Europe* points to the need to support the development of the cosmonautics industry as having the potential to increase the competitiveness of the European economy[154]. The development of this sector is also possible thanks to institutional partnerships implemented under the framework programmes of the European Commission – Clean Sky 2 in Horizon 2020, Clean Aviation in Horizon Europe. The Clean Aviation partnership is implemented jointly by the European Commission and the European aviation industry. Its aim is to develop and implement solutions for the aviation industry aimed at reducing the negative environmental impact of this economic sector while maintaining its competitiveness (sustainable aviation)[155].

Source: own study

5.1.2 Specialisation description and support areas

Taking into account the factors indicated in the previous chapter, RIS of the Podkarpackie Province introduces the necessary modifications in the Aviation and Cosmonautics specialisation, which, however, will have the character of cosmetic changes. Minor adjustments will also be made to the definition of areas presented in 2016 in the Action Plan for this specialisation.

Therefore, for the purposes of RIS of the Podkarpackie Province, it is assumed that: *Aviation will constitute a set of issues (technical, technological, organizational, marketing, process, etc.) related to all types of aircraft (including unmanned aircraft), produced for both civil and military purposes. This area also includes the construction, modernisation and maintenance of aviation infrastructure facilities, other facilities directly related to air transport activities, as well as air transport itself. Aviation also includes the production of fuels for this industry (especially alternative fuels), as well as research and scientific activities carried out for the development of this sector.*

The definition of cosmonautics adopted for the purposes of RIS of the Podkarpackie Province describes it as: *A set of activities related to the production of space equipment, including i.a. satellites, and the development and implementation of systems for their launch into space and activities aimed at using data obtained from these devices, including the provision of services using this data. This area also includes research and scientific activities carried out in the field of cosmonautics*.

[153] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. European Strategy in the field of aviation*, COM(2015) 598 final.

[154] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A New Industrial Strategy for Europe,* COM(2020) 102 final.

[155] https://europa.eu/european-union/about-eu/agencies/clean-sky2_pl [access 28.05.2021].

The Aviation and Cosmonautics industry will include entities operating within this specialisation, which have indicated the following sections of the PCA[156] classification as a type of activity:

1. Section C – Industrial processing:
   - Division 13 – Manufacture of textile products (13.92 – Manufacture of finished products textile products);
   - Division 19 – Manufacture of coke and refined petroleum products (19.20 – Manufacture and processing of refined petroleum products);
   - Division 22 – Manufacture of rubber and plastic products (22.19 – Manufacture of other rubber products);
   - Division 23 – Manufacture of other non-metallic mineral products (23.13 – Household glass production);
   - Division 24 – Manufacture of metals (classes: 24.51 – Iron casting, 24.53 – Casting of light metals);
   - Division 25 – Manufacture of fabricated metal products, excluding machinery and equipment devices (classes: 25.40– Manufacture of weapons and ammunition, 25.61 – Metalworking and metal plating, 25.62 – Machining of metal elements, 25.99 – Manufacture of other finished metal products, not classified elsewhere);
   - Division 26 – Manufacture of computer, electronic and optical products (classes: 26.51 – Manufacture of measuring, control and navigation instruments and instruments, 26.70 – Manufacture of optical instruments and photographic equipment);
   - Division 27 – Manufacture of electrical equipment (classes: 27.40 – Manufacture of lighting equipment, 27.90 – Manufacture of other electrical equipment);
   - Division 28 – Manufacture of machinery and non-classified equipment (classes: 28.11 – Manufacture of engines and turbines, excluding aircraft, automobile and motorcycle engines, 28.12 – Manufacture of hydraulic and pneumatic propulsion equipment and equipment, 28.15 – Manufacture of bearings, gears, gear transmissions and powertrains, 28.99 – Manufacture of other special purpose machinery not classified elsewhere);
   - Division 29 – Manufacture of motor vehicles, trailers and semi-trailers excluding motorcycles (29.32 – Manufacture of other parts and accessories for motor vehicles, excluding motorcycles);
   - Division 30 – Manufacture of other transport equipment (30.30 – Manufacture of aircraft, spacecraft and similar machinery);
   - Division 33 – Repair, maintenance and installation of machinery and equipment (classes: 33.12 – Repair and maintenance of machinery, 33.16 – Repair and maintenance of aircraft and spacecraft).

2. Section M – Professional, scientific and technical activities:
   - Division 71 Architectural and engineering activities; technical testing and analysis (classes: 71.12 – Engineering activities and related technical consultancy, 71.20 – Technical studies and analyzes);

156 Areas of activity indicated as predominant according to the PCA classification of 2007 in accordance with the Regulation of the Council of Ministers of 24 December 2007 on the Polish Classification of Activities (PCA), Dz.U.2007.251.1885.

- Division 72 – Research and development (72.19.Z – Research and developmental works in the field of other natural and technical sciences).

3. Section P – Education:
   - Division 85 – Education (85.53 – Extracurricular forms of driving education and pilotage).

The *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* will cover the following areas of support:

- Production of products that are ultimately used in the aviation and cosmonautical industry;
- Manufacture of aircraft and propulsion therefor, in particular aircraft (including special purpose aircraft, i.e. firefighting, agricultural, airtanker and agroforestry planes), helicopters, gliders, other means of air transport, and spacecraft;
- Construction and use of flight simulators;
- Research, development and production of avionics systems and their software;
- Development, construction and use of unmanned aerial vehicle systems (UAS) and their integration;
- Construction, modernization and maintenance of infrastructure facilities for aviation transport (including in peripheral areas of the province);
- Production of eco-friendly means of air transport that contribute to the protection of the environment;
- Production of fuel cells, including hydrogen;
- Production of low-emission aviation fuels, including hydrogen fuels;
- Development and implementation of solutions to ensure the safety of travel;
- Building capacity to upgrade and modify the aircraft fleet currently in use and helicopters in the aviation production plants of the Podkarpackie Province, the so-called retrofitting centers;
- Development and implementation of dual technologies (i.e. with both civilian and civil applications and military);
- Production of space equipment and its components along with the construction of infrastructure and space ascent systems;
- Activities related to astronomical observations and implementation of communication techniques and control and practical use of satellite technology, including the construction of infrastructure for space research and observation;
- Support for the development of technologies for processing data obtained from ships space and their use in economic and social practice.

For the development of specialisation, it is also necessary to support horizontal areas related to from:

- Digital transformation, development and implementation of Industry 4.0 solutions in the aviation industry and space;
- Implementation of solutions in the field of Circular Economy;
- Research and development activities directly related to the broadly understood sector of cosmonautics, aimed at implementing research results in production;
- Activities in the field of training personnel for the needs of the industry (including flying personnel and ground) and improving the competences of employees.

5.1.3 Key technologies and processes[157]

For the further development of entities related to aviation and cosmonautics in the coming years, the development of the following technologies will be important:[158]

- Automated safe air traffic control;
- Environmentally friendly aircraft designs with low noise and CO_2 emissions;
- Vertical take-off aircraft structures with variable wing geometry;
- Short/vertical take-off aircraft structures;
- The concept of aircraft inaudible outside the airport limits;
- Increasing the level of safety in the use of unmanned systems;
- Air transport safety, including the protection of airport infrastructure or satellite systems enhancing travel security and cybersecurity of aviation information systems;
- New innovative manufacturing technologies, including additive manufacturing technologies;
- Modernization of existing structures to reduce fuel consumption;
- Modernization of existing structures for adaptation for special purposes;
- Modern methods of subtractive production of aircraft assemblies in order to eliminate the number and weight of parts;
- Elimination of casting processes by replacing it with integral structures in the manufacturing of aeronautical units with reduced mass;
- Modern methods of manufacturing truss structures;
- IT solutions supporting the development of the aviation and space industry;
- Development and deployment of low-carbon fuels for cosmonautics;
- Construction of innovative aircraft and space propulsion systems;
- Electromagnetic technologies and techniques;
- Radio instruments and systems;
- On-board data systems;
- Miniaturization;
- Satellite technologies;
- Electrical power supply for space probes and satellites;
- Laser communication;
- The environment of the satellites (e.g., weather warning and forecasting tools);
- Supervision of space systems;
- Reducing the amount of so-called space debris;
- Management of missions and ground data systems;

[157] Key technologies in this and other specialisations have been identified on the basis of the literature as well as based on the indications of regional experts. It should be borne in mind, however, that since most of the industries forming the Podkarpackie smart specialisations are classified as high-tech sectors, and thus highly innovative, in which there may be a change in trends, the catalogue of indicated technologies should not be treated as closed and unchanging.

[158] Grabińska E. Grabowski S., *Nowe technologie na rynku przewozów lotniczych*, Zeszyty Naukowe Uniwersytetu Szczecińskiego. Ekonomiczne Problemy Turystyki, 2016 No. 2(34), pp. 240-243; Resolution Number 6 of the Council of Ministers of 26 January 2017 on the adoption of the Polish Space Strategy (M.P. 2017, poz. 203); ESA technology tree, https://www.gov.pl/web/rozwoj-praca-technologia/polityka-kosmiczna [access 06.06.2021].

- Processing of data obtained from space;
- Flight dynamics and GNSS (Global Navigation Satellite Systems) data processing systems;
- Development and applications of solutions in the field of automation, telematics and robotics, optics and optoelectronics for the space industry.

5.2 Automotive smart specialisation

5.2.1 Identification and fulfilment of criteria SS

Table 7. Completion of regional criteria for the identification of specialisation by Automotive SS

1. Proven current and prospective potential for smart specialisation, as well as the current and future relevance to region	The indication of Automotive as a regional smart specialisation has its justification in the defined potential of the region: • The automotive industry has a significant share of overall value industry and value of goods sold for export; • Automotive industry in Podkarpackie Province is characterized by a positive dynamics of revenues from the total activity; • Regional companies in this industry employ over 20,000 people; • The automotive industry is classified as a sector of high technologies, characterized by a high level of innovation; • Podkarpackie companies are participants in international supply chains – supply subassemblies and components for global automotive concerns[159].
2. The level of development of the Podkarpackie Province compared to the Polish and EU regions with the same or similar specialisation	• As compared to other regions characterised by the Automotive specialisation (i.e., Austrian Südösterreich and Italian Piedmont), Podkarpackie Province shows a lower value of synthetic innovation index (two former regions are included in the group of respectively 'strong +' and 'moderate +' innovators, while Podkarpackie is in 'moderate –'); • The Podkarpackie Province stands out among other regions with its the higher percentage of the population aged 30-34 with tertiary education, and higher number of applications for utility model reservations per billion PLN of regional GDP[160].

[159] Comp. *Monitoring*…, op. cit., pp. 48-52, *Wiodące branże*…, op. cit., pp. 19-26.
[160] *Monitoring*…, op. cit., pp. 28-29.

3. The possibility to show strict relation of smart specialisation with research and developmental potential of the regio	• The R&D potential of the automotive industry is represented primarily by the Rzeszów University of Technology. In the structures of the Faculty of Mechanical Engineering and Aviation, there is the Department of Combustion Engines and Transport, which has a rich laboratory base used for didactic purposes and for the needs of scientific research. Its scientific and research offer includes both research and equipment projects; • Directions of education related to the automotive industry are carried out by Jan Grodek State University in Sanok, Carpathian State College in Krosno and East European State Higher School in Przemyśl; • The province is distinguished by a higher number of scientific publications in the automotive field published in the Scopus database relative to the country average; • Training of human resources for the automotive industry is also implemented in many secondary schools, including schools participating in the implementation of the PAMISZ project.
4. Existing endogenous resources that prevent some forms of dependency and duplication	• The beginnings of the automotive industry date back to 1830s; • The Podkarpackie Province is characterized by a high concentration of entities related to automotive industry in the region, as compared to the country average. This may also translate into a higher than average potential for regional cluster initiatives and networking; • Regional automotive companies are mainly focused in the northern and western parts of the province, in special economic zones in Mielec and Tarnobrzeg, Stalowa Wola and Gorzyce; • Another area of high concentration of entities in automotive industry is the vicinity of Sanok; • Increasing transport accessibility of the region thanks to Rzeszów–Jasionka International Airport, the A4 motorway and the S19 expressway.
5. Presence or prospect of developing strong clusters in smart specialisation areas	There are 3 clusters in the region associating companies from the automotive industry: • Eastern Automotive Alliance; • 'Sanok Land' Industrial and Scientific Cluster; • Polish Automotive Group, granted the status of National Key Cluster.
6. The opportunity to grow and the use of directives and regulations defining economic paths and legal support by the European Union	• *Directive of the European Parliament and of the Council (UE) 2019/1161 of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles*[161]; • Strategy for sustainable and smart mobility, defining the directions for the development of European transport[162]; • Research and Innovation Programme Horizon Europe.

Source: own study

[161] *Directive of the European Parliament and of the Council (UE) 2019/1161 of 20 June 2019 amending Directive 2009/33/EC on the promotion of clean and energy-efficient road transport vehicles*, JoL EU 188 of 12.7.2019.

[162] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Sustainable and Smart Mobility Strategy*, COM(2020) 789 final.

5.2.2 Specialisation description and support areas

The automotive sector is systematically developing, which is why also in the case of this specialisation, RIS of the Podkarpackie Province must make the necessary adjustments to its scope, especially the areas of support. These changes will be minor modifications rather than significant remodeling. They mainly concern the inclusion in the specialisation of areas related to ecological means of transport, which in RIS3 have been assigned to the Quality of Life specialisation.

Therefore, the following definition is adopted for the purposes of RIS of the Podkarpackie Province: *Automotive is a broadly understood activity related to the production of motor vehicles, trailers, semi--trailers and rolling stock, including means of transport with a modern ecological drive, as well as the production of their components and products created for the needs of this sector. Specialisation is also created by research and scientific activities carried out for the needs of the industry*.

The Automotive industry will include entities operating within the scope of specialisation, which as an area of activity have indicated the following:

1. Section C – Industrial processing:
   - Division 29 – Manufacture of motor vehicles, trailers and semi-trailers, excluding motorcycles (classes: 29.10 – Manufacture of motor vehicles, excluding motorcycles, 29.20 – Manufacture of bodies for motor vehicles; manufacture of trailers and semi-trailers, 29.32 – Manufacture of other parts and accessories for motor vehicles, excluding motorcycles, 29.31 – Manufacture of electrical equipment and electronic for motor vehicles, 29.32 – Manufacture of other parts and accessories for motor vehicles, excluding motorcycles);
   - Division 30 – Manufacture of other transport equipment (30.91 – Manufacture of motorcycles);
   - Division 13 – Manufacture of textile products (classes: 13.20.A – Production of cotton fabric 13.92 – Manufacture of finished textile products);
   - Division 22 – Manufacture of rubber and plastic products (classes: 22.11 – Manufacture of rubber tyres and tubes; retreading and remanufacturing of rubber tyres, 22.19 – Manufacture of other rubber products, 22.29 – Manufacture of other plastic products);
   - Division 23 – Manufacture of products from other non-metallic mineral raw materials (classes: 23.12 – Shaping and processing of flat glass, 23.13 – Manufacture of household glass);
   - Division 24 – Manufacture of metals (24.51 – Iron casting, 24.53 – Casting of light metals);
   - Division 25 – Manufacture of metallic structural components, excluding machinery and equipment (classes: 25.61 – Metalworking and coating of metals, 25.62 – Mechanical processing of metal components, 25.72 – Manufacture of locks and hinges, 25.73 – Manufacture of tools, 25.99 – Manufacture of other finished metal products not classified elsewhere);
   - Division 26 – Manufacture of computers, electronic and optical products (26.51 – Manufacture of measuring, control and navigation instruments and instruments);
   - Division 27 – Manufacture of electrical equipment (27.20 – Manufacture of batteries and accumulators);
   - Division 28 – Manufacture of machinery and equipment n.e.c. (classes: 28.11 – Manufacture of engines and turbines, excluding aircraft, automobile and motorcycle engines, 28.12 – Manufacture of propulsion equipment and equipment hydraulic and pneumatic, 28.13 – Produc-

tion of other pumps and compressors, 28.15 – Manufacture of bearings, gears, gears and drive components, 28.20 – Manufacture of other general purpose machinery 28.30 – Manufacture of machinery for agriculture and forestry).

2. Section M professional, scientific and technical activities:
   - Division 71 – Architectural and engineering activities; technical testing and analysis (71.12 – Engineering activities and related technical consultancy),
   - Division 74 – Other professional, scientific and technical activities (classes: 74.10 – Specialist design activities, 74.90 – Other activities professional, scientific and technical not classified elsewhere).

The scope of pecialization will include the following areas of support:
- Design and manufacture of components used in the production of the automotive industry;
- Production of cars, buses, minibuses, motorcycles, tractors, semi-trailers, trailers, and special, mobile and military vehicles;
- Development and production of innovative eco-friendly forms of road transport (including public transport) together with the infrastructure for their operation;
- Development and production of modern drives;
- Development and production of modern technologies for powering electric vehicles (electrochemical batteries and hydrogen-powered fuel cells) cooperating with RESs;
- Development of innovative exhaust gas reduction systems and their implementation into production;
- Development of dual technologies (i.e. for both civilian and military applications);
- Design and manufacture of innovative materials and technologies for the production of means of transport and their components (including technologies for reducing the weight of vehicles);
- Construction and design of single-track and multi-track vehicles in unit production, for individual orders.

The development of specialisation will also require support in the field of horizontal issues related to:
- Digital transformation, development and implementation of Industry 4.0 solutions in the automotive industry, including i.a. the study of the process of detecting cracks in cut shapes using the cutting process;
- Implementation of solutions in the field of Circular Economy, including disposal and recycling of whole vehicles by selection and segregation by given alloys and their subgroups, disposal of batteries and power cells as environmentally harmful substances, recycling of tyres into primary raw materials for restocking;
- Research and development activities directly related to the broadly understood sector automotive, focused on the implementation of research results in production;
- Activities in the field of staff training for the needs of the industry and improving the competences of employees.

5.2.3 Key technologies and processes

To technologies and processes identified as key to the development of specialisation of Automotive, will include:

- Automation and robotization;
- Technologies related to the reduction of negative impact on the environment;
- Alternative sources of energy and the possibility of energy storage and the use of it at any time;
- Technologies used in the manufacture of electric vehicles and hydrogen;
- Advanced material technologies;
- Additive manufacturing techniques;
- Technologies for reducing exhaust emissions;
- Technologies related to the use of lightweight materials (including composites) and their construction;
- Methods of supplying solar energy to power electric vehicle assemblies;
- Technologies related to the design, manufacture of reliable software systems for controlling vehicle functions and communicating with the environment;
- Autonomous vehicle technologies;
- Modern processes of plastic processing of steel and aluminum alloys with high strength parameters allowing for the reduction of vehicles weight;
- Elimination of casting processes by replacing them with integral structures;
- Modern diesel engine injection systems for special vehicles and power generators;
- Technologies for recycling materials and components of motor vehicles.

5.3 Information and Telecommunications smart specialisation

5.3.1 Identification and fulfilment of criteria SS

Table 8. Completion of regional criteria for the identification of specialisation by Information and Telecommunications SS

1. Proven current and prospective potential for smart specialisation, as well as the current and future relevance to region	Potential of the ICT as smart specialisation results chiefly from an impact of the information and telecommunication technology on almost all areas of the social-economic development. The year 2020 caused the necessity to accelerate the development of the sector, through e.g., increase of demand for the digital solutions, including also more traditional sectors of economy such as tourism.

	The development of the sector is reflected in raising competitiveness and innovativeness of other SSs. The process of digitization accelerated as a result of the COVID-19 pandemic. The meaning of information-communication technologies and their influence on the more important branches of the regional economy in the Podkarpackie Province will in the future be still higher due to the progressing industrial revolution and the evolution of social needs. The Podkarpackie Province is characterized by a relatively high number of entities representing the ICT industry and this number is systematically increasing; The share of the ICT companies in the total number of the enterprises operating in the region consistently rises; The development of ICT should be fostered. ICT specialisation makes an important contribution to the growth of other regional SSs by targeting technologies related to: • Increasing business efficiency and scaling the sale of products; • The scope of data processing in the cloud (in this respect supporting the development of other ID); • Creating data centres; • Virtual and extended reality, computer animation for the economy; • The Internet of Things (and its successor, the Internet of Everything); • IT solutions for patient care and the elderly; • Implementation of applications supporting a high quality of life (including those related to the monitoring of health, environmental quality, the promotion of smart tourism, etc.)[163].
2. The level of development of the Podkarpackie Province compared to the Polish and EU regions with the same or similar specialisation	Among the comparative European regions (i.e., Portuguese Centro and Italian Provincia Autonoma Bolzano/Bozen), which also indicated ICT as their smart specialisation, Podkarpackie Province has the lowest value of synthetic innovation index. It should be noted, however, that it is characterized by a constant upward trend; In comparison with abovementioned regions, Podkarpackie Province is positively distinguished by the percentage of the population aged 30-34 with tertiary education, R&D expenditure in the enterprise sector expressed as a percentage of GDP and utility model reservation applications per billion PLN of the regional GDP[164].
3. The possibility to show strict relation of smart specialisation with research and developmental potential of the regio	• Training in areas related to ICT specialisation is implemented in all Podkarpackie universities; • Courses closely related to this specialisation are implemented by 8 universities; • Universities (primarily including the University of Technology in Rzeszów, University of Rzeszów, University of Information Technology and Management in Rzeszów) have a rich array of didactic and research laboratories, they also offer the implementation of scientific research in the field of information and communication technologies. In addition, the educational offer of the indicated universities is still developing, new directions and specialisations based on industry consultations are being launched, which are a response to the needs of the market, including the growing creative sector (in the region and beyond);

[163] *Monitoring*…, op. cit., p. 32.
[164] *Monitoring*…, op. cit., p. 33.

	• The region is characterized by relatively high expenditures internal for research and scientific activities compared to the number of employees13; • In the years 2015-2020, 35 inventions and patents in the ICT specialisation from the Podkarpackie Province have been registered; • The region also shows a higher share of publications that fit into the ICT specialisation and the area related to Industry 4.0, compared with the country average; • Training for work in professions aligned with the demands of ICT specialisation is also implemented in many secondary schools.
4. Existing endogenous resources that prevent some forms of dependency and duplication	Podkarpackie Province is characterized by high potential in Research and development services. In the region there are numerous educational units educating staff at both secondary and higher levels. Academic staff and students are successful in in the international robotics and programming competitions. Compared to other regions of the country14, Podkarpackie Province is characterized by a slightly different structure of ICT specialisation. A slightly smaller (although still dominant) share is held by companies conducting related activities with software and consulting in the field of IT, and more than in other regions are companies operating in the field of telecommunications and information services15. The region is home to the largest IT company in the country, Asseco Poland, which has achieved the status of an international corporation. In addition, companies and branches of large entities are developing in the province operating in the gaming industry, as well as entities from the audiovisual and advertising industry.
5. Presence or prospect of developing strong clusters in smart specialisation areas	There are two clusters associating ICT industry entities active in the province: • Eastern Poland IT Company Cluster, based in Rzeszów; • Cluster of Photonics and Fiber Optics from Lublin.
6. The opportunity to grow and the use of directives and regulations defining economic paths and legal support by the European Union	• A digital compass for 2030: the European road in the digital decade, vision and directions of digital transformation Europe[168]; • A European data strategy with a proposal for the creation of a single market for data1[169]; • White Paper on Artificial Intelligence, European approach to excellence and trust in promoting the development and deployment of AI based on European values[170].

Source: own study

[165] Applies to the outlays made by the enterprises belonging to the divisions 61-63 of the section J, comp. *Inteligentna specjalizacja*…, op. cit., p. 31.

[166] Identified in the report *Inteligentna specjalizacja*…, op. cit.

[167] *Inteligentna specjalizacja*…, op. cit., p. 18.

[168] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A digital compass for 2030: the European road in the digital decade*, COM(2021) 118 final.

[169] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. A European strategy for data*, COM(2020) 66 final.

[170] *White Paper on Artificial Intelligence A European approach to excellence and trust*, COM(2020) 65 final.

5.3.2 Specialisation description and support areas

Previous experience from the implementation of RIS3, as well as expert analyses, confirm that the scope of smart specialisation Information and Telecommunications has been well identified. Therefore, RIS of the Podkarpackie Province does not introduce significant changes in the area of this specialisation.

In view of the above, the following definition is adopted: *Information and Communication Technologies (ICT) are a group of technologies that process, collect and transmit information in an electronic form. The ICT sector includes companies engaged in the production of goods and services enabling the electronic recording, processing, transmission, reproduction or display of information*[171]*. The area of specialisation is also created by the research and scientific activities conducted for the ICT industry.*

ICT specialisation will include the enterprises operating witing this specialisation that have indicated the following areas of activity:

1. Division J – Information and telecommunications:
   - Division 61 – Telecommunications;
   - Division 62 – Activity associated with software, IT support and related activity;
   - Division 63 – Information service activities;

2. Section C – Industrial processing:
   - Division 26 – Manufacture of computer, electronic and optical products;
   - Division 58 – Publishing activities (58.2 – Software publishing activities);
   - Division 59 – Activities relating to the production of films, video recordings, television programmes, sound and music recordings (59.12 – Post-production activities relating to films, video recordings and television programmes);

3. Section M – professional, scientific and technical activities:
   - Division 72 – Research and development (classes: 72.19 – Research and developmental works in the field of other natural and technical sciences); 72.20 – Research and development in the social sciences and humanities; 72.21 – Public relations and communication);
   - Division 74 – Other professional, scientific and technical activities (74.90 – Other professional, scientific and technical activities not classified elsewhere).

[171] Comp. https://stat.gov.pl/metainformacje/slownik-pojec/pojecia-stosowane-w-statystyce-publicznej/1858,pojecie.html

The analysis of the areas of support for ICT specialisation indicated in the RIS3 Strategy shows that they have remained valid. More and more importance is attached to issues related to cybersecurity, which is why the catalogue of support areas within the RIS of the Podkarpackie Province has been extended by this scope:

- Production of information technology equipment;
- Software development and commercialization;
- Activities in the area of computer games (excluding their sale and excluding gambling);
- Activities related to computer animation carried out for the needs of computer game development industry;
- Design, commercialization and development of artificial intelligence and machine learning solutions, including robotics and their applications;
- Activities in the field of wired, wireless and satellite telecommunications;
- Development and commercialization of digital security solutions;
- Creating and disseminating digital solutions supporting the development of other specialisations;
- Production of electronic devices and their certification, i.a. electronic components and printed circuit boards, computers and peripherals, telecommunications equipment;
- Support for digitization activities for enterprises and public institutions from the region;
- Activity in the field of synthesis of distributed IT systems, production of their components (hardware and software), as well as development of the associated services that will ensure the improvement of many processes in the area of socio-economic activity;
- Support for the dissemination of new forms of digital communication;
- Activities in the area of visualization of BIG DATA and large data sets from various sources in order to optimize decision-making processes in enterprises;
- Support for the development and application of artificial intelligence methods and techniques;
- Activities in the field of integration of the entire environment in line with the concept of the Internet of Everything;
- Activities in the field of management of transformation projects;
- Dissemination and commercialization of information technologies;
- Support for standardization and cooperation activities for products and services;
- Activities in the field of ICT infrastructure, including i.a. the creation of new Data Centers.

In addition, the development of specialisation will also be strengthened by support directed to areas related to:

- Development and implementation of solutions in the field of digital transformation and Industry 4.0;
- Development and implementation of solutions in the field of Circular Economy;
- Research and development activities directly related to the broadly understood ICT sector, aimed at implementing research results in production and in society;
- Activities in the field of human resources training for the needs of the industry and improving the competences of employees (including the effective use of digital technologies, professional management, information transfer).

5.3.3 Key technologies and processes

ICT is an industry characterized by a fast pace of development. Dynamic changes also concern technologies that are important for the development of this branch of the economy. Therefore, it is difficult to identify those solutions that will play key roles in the perspective until 2030. The initial identification of such technologies was made by the Podkarpackie Innovation Center during work on the company's strategy. They are also in line with global trends. They are complemented by technologies and areas identified during consultations with regional ICT industry experts. These include technologies and processes related to the transformation of Industry 4.0, including e.g.:

- Hyperautomation, i.e. the combination of robotic process automation technology (RPA), artificial intelligence (AI) and machine learning;
- Fifth generation (5G) mobile technology;
- Transhumanism, i.e. the use of science and technology to expand capabilities of the human body;
- Marketing and sales automation;
- Moving services and services to cloud platforms and as a complement and extension of their capabilities – Edge Computing, i.e. storing and processing data close to the place of use in order to shorten response time and increase throughput;
- Blockchain technology and its application in practice, including smart contracts (binding contracts concluded without the presence of a trusted third party, e.g., a notary);
- Cybersecurity solutions;
- Other applications of artificial intelligence and machine learning;
- Industrial data collection, processing and inference systems[172];
- Engineering and analysis of big data sets (Big Data) in order to acquire hidden knowledge and new rules of inference;
- Digital twin technologies as the virtual equivalent of a physical object or process in real time for fully automated processes;
- Biotechnology using it tools for gene analysis;
- Construction of biocybernetic systems;
- Virtual reality (VR) and augmented reality (AR), computer animation and their potential applications in many areas of socio-economic life;
- The Internet of Things (IoT) and the development of the concept of its successor, the Internet of Everything (IoE);
- Technology for product identification using radio waves (RFID);
- 3D print;
- Mobile interfaces;
- Technologies using biometrics and visual computing.

[172] *Inteligentna specjalizacja*…, op. cit., pp. 25-26.

5.4 Quality of Life smart specialisation

5.4.1 Identification SS and its evolution

Quality of Life smart specialisation in its design and scope is definitely different from other regional specialisations of Podkarpackie Province. It does not include a single, compact branch of the economy, but several areas more or less closely related to each other.

Already in the update of the *Regional Innovation Strategy of the Podkarpackie Province for 2005-2013* that was adopted in 2011, several high-opportunity sectors were identified, which then became the foundations of the Quality of Life specialisation. These included:

- Organic farming and food industry;
- Services, including tourism services;
- Chemical industry, including pharmaceutical;
- Industry related to environmental protection infrastructure;
- Industry of equipment for the acquisition and use of renewable energy sources;
- The industry of natural plant medicines and the development of centers for their search.

These industries contributed to the economic development of the province, but they did not have enough potential to create an independent specialisation.

At the stage of developing the RIS3 Strategy, the Local Government of Region saw the need to identify a specialisation that, in addition to the other SS, will cover the entire region, thus enabling the improvement of the quality of life in the province. Therefore, after analyzing the potentials of industries, including their competitive advantages, as well as after consultations with stakeholders, the Quality of Life specialisation was created, including the following areas:

- Production and processing of food of the highest biological and health quality, organic and sustainable agriculture and processing, regional and traditional products;
- Sustainable and responsible tourism, health and well-being;
- Eco-technologies: renewable energy sources,
- Energy-savings and ecological devices.

First experience with the implementation of RIS3 and the translation of smart specialisations into support instruments have shown that the scope of Quality of Life is wide enough to include almost all projects and activities, including those that do not have much in common with areas of specialisation. Therefore, in 2016, RIS3 was updated, specifying the scope of individual specialisations within the framework of the prepared Action Plans. In the *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020*, the Quality of Life includes areas that are considered subspecialisations:

- Mobility;
- Climate and energy;
- Sustainable tourism (excluding mass tourism);
- Health, food, nutrition, innovative technologies, processes and products of the agrifood of the highest biological and health quality.

The 2016 RIS3 update did not solve all the difficulties associated with this specialisation. On one hand, its scope was quite wide, but at the same time, especially in the case of the area related to food production, it limited access to support for a relatively large part of entrepreneurs of a given industry. Areas such as mobility, which have stronger links with the automotive industry than the Quality of Life, have been included in it. In addition, the sectors forming the subspecialisations were relatively loosely interrelated, which meant that there was a lack of active cooperation between entities representing different industries. There was also no entity emerging that would act as a leader and representative of the entire specialisation. Entities included in the Quality of Life specialisation are located throughout the Podkarpackie Province, thus ensuring more sustainable development of the region.

Currently, there is still a need to ensure a more even development of the region, and thus support branches of the economy that cover a larger area of the province, and at the same time have the opportunity to use the endogenous resources of the province. The aforementioned need is also confirmed by the representatives of enterprises and associations operating in the area of specialisation. It should be noted, however, that none of these areas has developed enough to become an independent smart specialisation. Therefore, RIS of the Podkarpackie Province will maintain the Quality of Life SS, but in a slightly changed formula. Its development will be based on four interrelated pillars (sub-specialisations), i.e.:

- Sustainable tourism;
- High-quality food;
- Medical and fitness services and products;
- Environmentally friendly energy.

Each of the areas of specialisation remains in a dynamic relationship with the others. The first three areas are related to the maintenance of good physical and mental condition and health, while the development of the last area will allow to maintain a high quality of the natural environment, which will also be conducive to maintaining the health of the inhabitants of the province, and will also boost tourist attractiveness of the region. At the same time, the specialisation will be in line with the assumptions of the Circular Economy, focused e.g., on environmental protection, as well as on the EU policy on the Green Deal.

Sustainable tourism uses in its activities products manufactured by the entities belonging to the high-quality food subspecialisation. Tourist culinary trails are successfully operating in the region. Health tourism, which is one of the branches of sustainable tourism, is also closely related to the area of medical and fitness improvement services and products. Thanks to this, the levels of innovation and competition in tourism, which is one of the more 'traditional' branches of the economy, is also increasing.

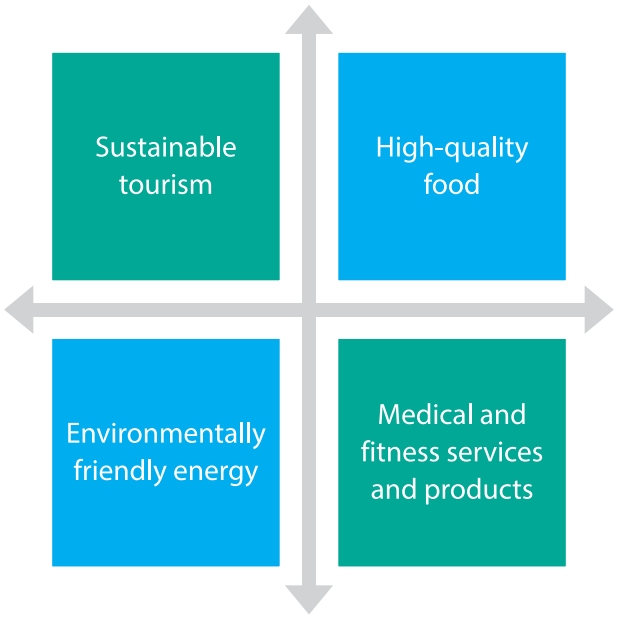
The sector of Medical and fitness improvement services and products thanks to health tourism is provided with an additional market for its activities, and using the achievements of the high-quality food sector, it supports the processes of treatment and regeneration of the body. Obvious relationships exist between maintaining a proper diet and the state of health. The existing links between these three areas concern both the outlets for products and services and the use of similar scienti-

fic resources and innovation processes. Equally important are the relationship between sustainable nutrition and food conservation and environmental protection and combating climate change.

The environmentally friendly energy area also shows links with other sub-specialties. By enabling the preservation of a high-quality natural environment, it supports the image of the Podkarpackie Province as a clean, ecological and attractive region for tourists. Thus, it strengthens the development of other subspecialisations. It should also be noted that entities forming the area of environmentally friendly energy conduct research and development activities,in which products for other specialisations are sometimes created, e.g., a non-invasive device for diagnosing COVID-19 infection. The area sometimes uses by-products of other subspecialisations for the creation of RES technologies, e.g., decomposing organic waste in biogas plants.

Each of the areas of Quality of Life specialisation shows a dynamic growth, and the links existing in the region between them allow each other to support the growth of their competitiveness and innovation.

Figure 32. Layout of areas that make up the Quality of Life specialisation



Source: own study

Each of these areas makes a significant contribution to the socio-economic development of the province. One of the important industries for the region is undoubtedly sustainable tourism. The term Sustainable tourism is understood as all types of tourism activities whose implementation is economically justified, using the resources of the region without over-exploiting them and which at the same time are accepted by the local community[173]. Sustainable tourism understood in this way enables the economic development of the province, emphasizing the need to take into account the economic and socio-cultural aspects, as well as ecological neutrality in the conducted tourism

[173] Młynarczyk Z., Potocka I., Zajadacz A. (red.), *Uwarunkowania i plany rozwoju turystyki. Tom VI Turystyka zrównoważona,* Bogucki Wydawnictwo Naukowe, Poznań 2010, p. 8.

activities[174]. In other words, its aim is to make optimal use of the natural resources of the environment and to respect social and cultural traditions of the community while providing socio-economic benefits[175].

Tourism, especially its active forms, serves to keep the human body in good condition, and thus maintain health. However, it should be noted that virtually any form of tourism contributes to the maintenance of good physical and mental health. Focusing the development of Podkarpackie tourism on areas related to its sustainable character, as well as to maintaining health and improving the general human condition will allow it to be specialized, what is an opportunity to increase the level of its competitiveness.

The development of tourism in the Podkarpackie Province is quite closely related to the production of food, including in particular traditional food. Clean air and high values of the natural environment of the region are one of the factors constituting the hallmark of the area, affecting the increase in tourist traffic. These conditions are also excellent for the production of high-quality food. It should be noted that this area will become increasingly important due to the growing awareness and expectations of consumers towards food producers to provide high-quality products without unnecessary additives, such as all kinds of preservatives and flavor enhancers. Such foods, often processed to a lesser extent and made from natural ingredients, are undoubtedly healthier and contribute to better condition of the body. At the same time, the production of high-quality food should be aligned with the circular economy trends related to e.g., the need to reduce food waste, at the stage of its production, storage, distribution and consumption.

When describing this subspecialisation, it is necessary to emphasize the distinction between agricultural activities aimed at obtaining raw material in its original form (the so-called product of first processing) and activities aimed at its processing, packaging or storage. In accordance with the policy of the European Union, the first of these areas is supported under the Funds of the Common Agricultural Policy[176], thus not falling within the scope of the RIS of the Podkarpackie Province.

The food sector is also associated with the area of medical and fitness services and products. The implementation of various prevention programmes, as well as the continuing state of the pandemic increase public awareness of the need to maintain good health and condition of the body. The segment related to the production of medicines and dietary supplements aimed at supplementing deficiencies of vitamins and microelements, which are insufficiently supplied in food, is developing significantly. Products and services for faster recovery or for providing proper care to the elderly also play an important role. Spas, which are very important for the acceleration of convalescence are also frequent destinations for tourist traffic in the Podkarpackie Province due to their attractive location and natural values. The spa & wellness sector is also gaining more and more popularity among tourists, what also contributes to maintaining good condition, both physical and mental body.

174 Kaźmierczak M., *Turystyka zrównoważona synonimem turystyki zorientowanej etycznie*, Studia Periegetica 2009, No. 3, Teoria i praktyka w turystyce, p. 14.

175 https://web.archive.org/web/20170720181411/http://sdt.unwto.org/content/about-us-5 [access 25.06.2021].

176 *Treaty on the Functioning of the European Union*, Dz.U. C 326 of 26.10.2012.

The development of each of these areas will also be influenced by the strengthening of the sector related to the production of energy from renewable sources. The Podkarpackie Province is one of the cleanest regions in the country. This, however, does not waive our responsibility for the reduction of the impact human activity has on the natural environment. This can be achieved by e.g., the development of technologies related to the extraction of energy from renewable sources. The subspecialisation of environmentally friendly energy will contribute to the preservation of the great natural values of the Podkarpackie Province, thus affecting other areas of this SS. Popularization of the use of photovoltaic panels and solar collectors or heat pumps not only reduce the negative impact on the environment (compared to traditional heat sources and energy) but also contribute to reduction of the business costs. In addition, products created by the entities of this industry are used in e.g., medical diagnostics. This area also designs solutions for other specialisations, such as the development and implementation of low-carbon fuels from renewable energy sources for Aviation and Cosmonautics and Automotive specialisations.

As can be seen from the above analysis, all indicated areas of specialisation are interrelated, thus having a mutual impact on development. At the same time, none of the areas alone currently has sufficient potential to indicate it as a separate specialisation. Therefore, it was decided to combine them into one SS until they strengthened enough to become an independent specialisation.

5.4.2 Fulfilment of criteria SS

Table 9. Completion of regional criteria for the identification of specialisation by Quality of Life SS

1. Proven current and prospective potential for smart specialisation, as well as the current and future relevance to region	• Quality of Life specialisation (including all constituent areas) plays an important role in the economic proceedings of the region; • In contrast to other specialisations, Quality of Life does not focus on one area. The entities creating it cover the area of almost the entire province, thus balancing the development processes; • Each of the areas identified in the new layout in specialisation Quality of Life is already distinguished by a large development potential, which should increase over time; • Podkarpackie Province is characterized by high natural and cultural values, having the potential to develop active tourism, as well as less demanding forms of spending free time; • The region has recognizable tourist products, as for example of the Bieszczady Mountains, Castle Museum in Łańcut, Town of Przemyśl and religious buildings inscribed on the UNESCO list; • One of the most popular forms of tourism in the Podkarpackie Province is active, sightseeing, leisure tourism – each of these forms contributes to maintaining good health and condition of the body; • There are 5 spas in the region, constituting potential for the development of spa healing and tourism;

	• The region is characterized by a large development potential of enotourism related to favourable natural conditions as well as the functioning of vineyards and wineries; • There is an increase in the guest accommodation capacity in the region; • The province is among country leaders in regard to the number of accommodation in agritourism farms[177]; • The region boasts one of the highest numbers of the registered traditional food products in the entire country; • Growing food production in the region premium; • Increasing share of food exports in general value exports, the average annual growth of this ratio exceeded 20%; • Ice cream is included in the list of the most important export products of the region, and the export value experiences positive dynamics[178]; • Increasing public awareness of the role of prevention and the need to take care of the good psychophysical condition of the body, as well as the need to reduce the negative impact on the natural environment; • The changing demographic structure and ageing societies increasing demand for a variety of services and products related to the provision of adequate care for the elderly; • Deteriorating health of the society, related to, among others with the COVID-19 pandemic; • Rapid advancement of medical science and its implications demand for innovative devices, products and technologies that will be used in medicine; • The presence of large pharmaceutical producers in the region; • The pharmaceutical industry is included in the sectors of high technology; • Medicines are one of the most important export products of the region[179]; • The development potential of herbalism associated with favorable natural conditions, the functioning of the „Herbalism" education course at the Carpathian State College in Krosno and the possibilities of using herbal plants in dietetics and cosmetology; • Developmental potential associated with research on the implementation of hydrogen technologies and creation of the first Hydrogen Valley in the region; • Implementation of the European Green Deal imposing an obligation on EU Member States to strive for climate neutrality; • In 2018, 6th place in the country in terms of share of energy from renewable sources in total electricity production (value almost twice as high as the average for Poland); • Export of Podkarpackie Region of hydraulic turbines, water wheels and their regulators constitute 45.7% of the share in domestic exports in 2019; • The development of renewable energy sources is an opportunity for achieving energy independence.

177 *Audyt turystyczny województwa podkarpackiego*, 2BA doradztwo strategiczne, Nysa–Kraków–Rzeszów 2019, p. 8-55.

178 *Handel zagraniczny*…, op. cit., p. 36, regarding the list of the most important export products of Podkarpackie Province analyzed on PCA class level (4 digits).

179 Ibidem, regarding the list of the most important export products of Podkarpackie Province analyzed on PCA class level (4 digits).

2. The level of development of the Podkarpackie Province compared to the Polish and EU regions with the same or similar specialisation	• Comparative Regions[180] for Quality of Life are: Sachsen-Anhalt (Saxony-Anhalt, Germany) and Nordjylland (Northern Jutland, Denmark); • Both regions are considered strong innovators, which means that they achieve higher values of the synthetic indicator of innovation. However, it should be noted that unlike the former two regions, the Podkarpackie Province recorded constant growth trend of that index; • When compared with these two regions, Podkarpackie Province is distinguished by a higher value of the sales of market and company-level innovation in SMEs as a percentage of turnover, and R&D expenditure in the enterprise sector as a percentage of GDP.
3. The possibility to show strict relation of smart specialisation with research and developmental potential of the regio	• Research in areas of Quality of Life specialisation is implemented, among other thing, by the scientific staff of the Rzeszów University of Technology, the University of Rzeszów, the University of Information Technology and Management in Rzeszów or the Carpathian State College in Krosno; • There are over 30 accredited research and scientific laboratories[181], operating, among others, in areas related to food research, agricultural production, pharmaceuticals or environmental protection, thus supporting the development of the specialisation Quality of Life; • Participation of scientific publications related to Quality of Life published in the Scopus database in the Podkarpackie Province region is 6% higher than the country average. Most often, they focus on issues related to medicine and renewable energy sources. It should also be noted that the share of publications related to the tourism area is twice as high as the country average; • Education in the fields related to SSs is conducted by almost all universities and colleges in Podkarpackie Province; • Education related to the needs of the industries related to the Quality of Life is also conducted in many secondary schools.
4. Existing endogenous resources that prevent some forms of dependency and duplication	Development of Quality of Life specialisation is based on endogenous resources of the Podkarpackie Province: • Quality of Life is characterized by a high level of regional concentration of entities included in this specialisation; • Clean, and well-preserved natural environment. • Resort advantages (mineral and thermal waters); • Border location; • Multicultural heritage; • Well developed agritourism infrastructure (compared to other regions of the country); • ‚Podkarpackie Smaki', one of the largest culinary trails in Poland; • 2 regional products registered on the European Commission list (out of 36 products from Poland); • Wide selection of the regional Traditional Products (including bread, cheeses, honeys, cold meats, preserves); • Developing online sales of regional products from Podkarpackie Province; • Natural conditions conducive to the development of ecological processing; • College of Medical Sciences established at the University in Rzeszów;

[180] Indicated in *Monitoringu*…, op. cit.,

[181] https://www.pca.gov.pl/akredytowane-podmioty/akredytacje-aktywne/laboratoria-badawcze/ [access 07.06.2021].

	• Dozens of years of traditions related to the production of pharmaceuticals; • Good natural conditions for the development of RES infrastructure; • Hydro Power Plant Complex located in the region; • The first Hydrogen Valley in Poland was established in the Podkarpackie Province.
5. Presence or prospect of developing strong clusters in smart specialisation areas	• Quality of Life as a specialisation combining many areas is distinguished by the multitude of cluster initiatives operating in the region: • Carpathian Tourism Cluster • 'Land of the Podkarpackie Province' Quality of Life Cluster; • Przemyśl Tourism Cluster • 'Strug Valley' Microregion Tourism Cluster; • 'PODKARPACKIE SMAKI' Cluster; • 'Valley of Ecological Food' Cluster, • Podkarpackie Organic Food Cluster; • Podkarpackie Agrofood Cluster; • Podkarpackie Prevention and Health Cluster; • Technology in Medicine Cluster (Technomed Cluster); • Subcarpathian Renewable Energy Cluster; • Southern Podkarpacie Energy Cluster; • Solina Energy Cluster; • Rzeszów Renewable Energy Sources Cluster; • Environment and Energy Initiative Cluster.
6. The opportunity to grow and the use of directives and regulations defining economic paths and legal support by the European Union	• *Directive of the European Parliament and of the Council (UE) 2015/2302 of 25 November 2015 on package travel and related travel arrangements, amending Regulation (EC) No 2006/2004 and Directive 2011/83/EU of the European Parliament and of the Council and repealing Council Directive 90/314/EEC*[182]; • *Tourism and transport in 2020 and beyond* underlining the need to promote sustainable nature of the tourist ecosystem[183]; • *Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority (EFSA) and laying down procedures in matters of food safety*[184]; • *Biodiversity Strategy for 2030 Bringing nature back into our lives*, including the need to guarantee food security[185];

[182] *Directive of the European Parliament and of the Council (UE) 2015/2302 of 25 November 2015 on package travel and related travel arrangements, amending Regulation (EC) No 2006/2004 and Directive 2011/83/EU of the European Parliament and of the Council and repealing Council Directive 90/314/EEC*, JoL EU 326 of 11.12.2015.

[183] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Tourism and transport in 2020 and beyond*, COM(2020) 550 final.

[184] *Regulation (EC) No 178/2002 of the European Parliament and of the Council of 28 January 2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority (EFSA) and laying down procedures in matters of food safety*, JoL EU 031, 01/02/2002, P. 0001–0024.

[185] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. Biodiversity Strategy for 2030 Bringing nature back into our lives*, COM(2020) 380 final.

	• *Regulation of the European Parliament and of the Council (UE) 2021/522 of 24 March 2021 on the establishment of the Union Programme for Action in the field of Health ('the EU Health Programme') for the period 2021-2027 and repealing Regulation (EU) No 282/2014*[186]; • *Directive of the European Parliament and of the Council (UE) 2018/2001 of 11 December 2018 on promoting the usage of energy from renewale sources*[187]; • *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal*[188].

Source: own study

5.4.3 Specialisation description and support areas

Due to the remodeling of the smart specialisations, the Quality of Life definition also had to be modified. In view of the above, for the purposes of the RIS of the Podkarpackie Province, it is assumed that: *Quality of Life is a complex of interrelated sectors whose products and/ or services are intended to meet the needs of in the field of improving the quality of life of the society, including in particular in the field of health. The above set of activities covering sustainable tourism, high-quality food, medical and fitness services and products, as well as environmentally friendly energy will enable the sustainable development of the Podkarpackie Province*.

The specialisation include the entities registered under the following PCA divisions:

1. Sustainable tourism subspecialisation:

a. Section H – transport and storage:
   - Division 49 – Land transport and pipeline transport (49.39 – Other passenger land transport, not elsewhere classified – includes, among others, excursion and tourist transport, cable cars, ski lifts).

b. Section I – Activities related to accommodation and catering services:
   - Division 55 – Accommodation;
   - Division 56 – Food service activities.

c. Section M – professional, scientific and technical activities:
   - Division 72 – Research and development (classes: 72.19.Z – Other research and experimental development on natural sciences and enginnering, 72.20.Z – Research and experimental development on social sciences and humanities.

d. Section N – administrative services and support activities:
   - Division 77 – Hire and lease (77.21 – Rental and leasing of recreational and sports goods);

[186] *Regulation of the European Parliament and of the Council (UE) 2021/522 of 24 March 2021 on the establishment of the Union Programme for Action in the field of Health ('the EU Health Programme') for the period 2021-2027 and repealing Regulation (EU) No 282/2014*, JoL EU 107 z 26.3.2021.

[187] *Directive of the European Parliament and of the Council (UE) 2018/2001 of 11 December 2018 on promoting the usage of energy from renewale sources*, JoL EU 328/82 of 21.12.2018.

[188] *Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. The European Green Deal*, COM(2019) 640 final.

- Division 79 – Activities of tour operators, intermediaries and tourist agents and other booking service activities and related activities.

e. Section Q – human health and social work activities:
- Division 86 – Healthcare (86.10.Z – Activities of hospitals, including activities of preventive offices, sanatoriums, rehabilitation centers and other medical facilities providing patients with accommodation and food in the scope of entities providing services in the field of tourism activity).

f. Section R – activities related to culture, entertainment and recreation:
- Division 90 – Creative activities related to culture and entertainment (90.04 – Operation of arts facilities);
- Division 91 – Activities of libraries, archives, museums and other cultural activities (classes: 91.02 – Activities of museums, 91.03 – Activities of historical places and buildings and similar tourist attractions, 91.04 – Activities of botanical and zoological gardens and nature conservation areas and objects);
- Division 93 – Sports, entertainment and leisure activities (classes: 93.19 – Other sports activities – in the field of mountain guides, 93.2 – Entertainment and recreational activities).

g. Section S – Other service activities:
- Division 96 – Other individual service activities (96.04 – Physical well-being activities).

2. High quality food subspecialisation:

a. Section A – agriculture, forestry, hunting and fishing:
- Division 01 – Agricultural crops, animal husbandry, hunting, including service activities.

b. Section C – Industrial processing:
- Division 10 – Manufacture of foodstuffs;
- Division 11 – Beverage production.

c. Section I – Activities related to accommodation and catering services:
- Division 56 – Food service activities.

d. Section M – professional, scientific and technical activities:
- Division 72 – Research and development (classes: 72.11 – Research and experimental development on biotechnology, 72.19.Z – Other research and experimental development on natural sciences and engineering).

e. Section N – administrative services and support activities:
- Division 82 – Office provisioning and other activities business support activities (82.92 – Packaging activities).

3. Medical and fitness services and products subspecialisation:

a. Section C – Industrial processing:
- Division 21 – Manufacture of essential pharmaceutical substances and medicines and other pharmaceutical products (classes: 21.10 – Manufacture of basic pharmaceutical substances, 21.20 – Manufacture of medicines and other pharmaceutical products);
- Division 32 – Other manufacture of products (32.50.Z – Manufacture of equipment, medical instruments and devices, including dental devices).

b. Section M professional, scientific and technical activities:
   - Division 72 – Research and development (classes: 72.11 – Research and biotechnology development, 72.19.Z – Other research and experimental development on natural sciences and technical).

c. Section Q – Human health services and social work activities:
   - Division 86 – Healthcare (classes: 86.90.A – Physiotherapeutic activities; 86.90.D – Paramedical activities; 86.90.E – Care and health activities, not classified elsewhere; 86.10.Z – Hospital activities, including the activities of preventive offices, sanatoriums, rehabilitation centers and other medical facilities providing patients with accommodation and food).

4. Environmentally friendly energy subspecialisation:

a. Section D – Generation and supply of electricity, gas, steam:
   - Division 33 – Repair, maintenance and installation of machinery and equipment (33.20 – Installation of industrial machines and equipment and outfit);
   - Division 35 – Production and supply of electricity, gas, steam, hot water and air for air conditioning systems (classes: 35.11 – Production of electricity, 35.12 – Transmission of electricity, 35.21 – Manufacture of gaseous fuels, 35.30 – Steam, hot water and air conditioning manufacturing and supply).

b. Section F – Construction:
   - Division 41 – Construction works related to the construction of buildings (classes: 41.10 – Implementation of construction projects related to the construction of buildings, 41.20 – Construction works related to the construction of residential and non-residential buildings);
   - Division 43 – Specialised construction works (classes: 43.21 – Electrical installation, 42.99 – Works related to construction of other civil engineering structures not classified anywhere else.

c. Section C – Industrial processing:
   - Division 23 – Manufacture of products from other non-metallic mineral raw materials (23.11 – Manufacture of flat glass);
   - Division 26 – Manufacture of computer, electronic and optical products (26.11 – Manufacture of electronic components);
   - Division 27 – Manufacture of electrical equipment (27.20 – Manufacture of batteries and batteries).

d. Section E – Supply of water; wastewater and waste management and activities related to reclamation:
   - Division 39 – Reclamation and other activities related to waste management.

e. Section M professional, scientific and technical activities:
   - Division 71 – Architecture and engineering activities; research and technical analyses (Classes: 71.12 – Engineering and related activities in technical consultancy, 71.20 – Technical research and analysis);
   - Division 72 – Research and development (classes: 72.11 – Scientific research and development work in the field of biotechnology, 72.19.Z – Other research and experimental development on natural sciences and technical).

The Quality of Life specialisation will support the following areas:

1. In terms of the sustainable tourism subspecialisation:
   - activities in the area of health tourism (including medical, spa, spa & wellness);
   - activities in the area of active tourism (including qualified tourism);
   - activities in the field of sightseeing tourism (including natural and business tourism);
   - activities in the field of cultural tourism (including in the area of creative industries, religious, historical and military tourism);
   - activity in the field of educational tourism.

2. In terms of high-quality food subspecialisation:
   - production and processing of high-quality food;
   - organic and sustainable agriculture and processing;
   - food packaging activities, in particular in the field of development and the use of eco-friendly packaging;
   - production and processing of regional and traditional products, sourcing of herbals and their processing into the finished product;
   - activities in the field of food storage, including finished foodstuffs to maintain its high quality;
   - activities in the field of production of functional food;
   - innovative processing of agricultural products promoting quality and awareness of the consumers for health-promoting nutritional values.

3. Medical and fitness services and products subspecialisation:
   - activities in the field of prevention, including targeted prophylactic health care, in particular in the area of preventive examinations addressed to the elderly;
   - activity in the area of spa treatment, including medical clinics;
   - activities in the field of rehabilitation, in particular innovative methods of rehabilitation;
   - activities in the area of convalescence;
   - activities in the area of care for the elderly and dependents, including telecare;
   - activity in the area of development, production and commercialization of solutions supporting the functioning of people with disabilities and the elderly;
   - production of medicines;
   - production of high-end dietary supplements;
   - production of food for special medical purposes;
   - manufacture of medical equipment;
   - activity in the area of prehabilitation (multidirectional preparation of the patient for treatment, including surgical treatment);
   - activity in the field of modern medical diagnostics,
   - activity in the field of innovative therapies, including minimally invasive therapies.

4. Environmentally friendly energy subspecialisation:
   - production of energy from renewable sources (solar, wind, hydro, geothermal, energy from biomass, alternative fuels);
   - activities in the development and use of alternative fuels technologies;
   - activities in the field of distributed energy development;

- production of equipment for obtaining energy from renewable sources;
- construction, modernization and maintenance of infrastructure of renewable energy;
- development of Smart solutions in the area of production, transmission and storage regulation and energy consumption (e.g. smart grids, smart home systems);
- development of electricity storage techniques in smart systems of power grids;
- construction and integration of energy storage with RES installations;
- development of complementary energy distribution infrastructure originating from e.g., RES to ensure favorable conditions for the transition to low-emission transport based on electric vehicles;
- production and activities in the field of waste heat use;
- activities in the field of development of innovative thermal energy technologies, including hybrid technologies enabling the production of electricity and heat;
- activities in the field of hydrogen energy development.

For the development of specialisation, it is also necessary to support horizontal areas related to:

- Digital transformation, development and implementation of Industry 4.0 solutions in the industries belonging to the Quality of Life specialisation;
- Implementation of solutions in the field of Circular Economy in entities belonging to the specialisation, including solutions to support companies in achieving carbon neutrality;
- Research and development activities directly related to the Quality of Life specialisation, including those aimed at testing the effectiveness of developed solutions and implementing research results in production;
- Activities in the field of staff education for the needs of specialisation industries and raising competence of the employees.

5.4.4 Key technologies and processes

For the individual areas of Quality of Life specialisation, the following key technologies and processes:

1. Sustainable tourism:
   - Smart tourism, including systems for managing (and monitoring) the flow of tourists;
   - Eco-innovations;
   - Renewable energy sources for tourism farms/businesses;
   - Production of biodegradable materials for use in tourism/gastronomy;
   - Low-cost solutions that reduce the amount of garbage produced and water consumed;
   - Overtourism in the most popular places and redistribution of tourist traffic;
   - Integration of information and communication technologies into physical infrastructure.
2. High quality food:
   - Innovative communication and educational tools to help consumers make informed food choices;
   - Innovative marketing tools to promote high-quality food;
   - Biotechnologies;

- Technologies that increase the expiry date of regional and traditional products;
- Solutions using renewable energy sources;
- Technologies to increase native health-promoting biologicalky active ingredients in functional food;
- Systems that facilitate task planning and precise execution.

3. Medical and fitness services and products:
   - Technologies used in the field of medical diagnostic systems;
   - Advanced solutions, based on robotics, artificial intelligence tools and tools using big data analytics;
   - Development of peripheral devices for measuring medical parameters, including also devices implanted subcutaneously, supported by applications based on artificial intelligence;
   - Modern imaging systems and methods, including 3D imaging and holography;
   - Telemedicine and health monitoring supported by artificial intelligence (AI) algorithms;
   - Remote monitoring of patient parameters related to post COVID-19 complications;
   - Innovative technologies and systems in the field of modern therapies and rehabilitation,
   - Telesurgery (treatments performed at a distance);
   - Nanomedicine;
   - Innovative tools that increase precision and efficiency, including medical robots, rehabilitation, pharmacy and medical navigation systems;
   - Modern techniques of surgery and orthopedic support: 3D printing, methods of rapid prototyping, reverse engineering methods;
   - Biotechnologies;
   - Technologies to innovate new medicinal products used not only in medicines, but also in dietary supplements, medical devices, cosmetics;
   - Development of a digital educational platform dedicated to broadly understood health promotion;
   - Rehabilitation games.

4. Environmentally friendly energy:
   - Technologies for the use and related use of hydrogen as an energy carrier the entire economic chain: its production, storage, transport and use (including e.g., hydrogen storage technologies in solid state, technologies of high-performance electrolysers with a proton membrane based on two-dimensional materials, technologies of fast and precise detection of hydrogen and its quality, technologies of co-combustion of hydrogen in gas turbines and production of renewable hydrogen in the electrolysis process);
   - Technologies based on zero-, one- and two-dimensional materials, which are the latest materials developed in photovoltaics (PV);
   - Technologies for integrating different materials in construction of high-performance multi-connector cells, operating in the UV, VIS, IR (PV) range;
   - Technologies for the integration of high-performance multi-junction cells with electrolysers for 'pure green energy' generation (hybrid of hydrogen and PV);
   - Technologies for disposal of used PV panels, car batteries, energy storage and other elements of RES installations.

6 Vision, mission and strategic goals of the RIS of the Podkarpackie Province

The vision of RIS of the Podkarpackie Province is a visualization of the desired state of development of the region, which will be achieved through the implementation and implementation of the provisions of the strategy. The diagnosis of the Podkarpackie system of innovation, internal and external factors affecting its efficient functioning makes it possible to formulate the following vision:

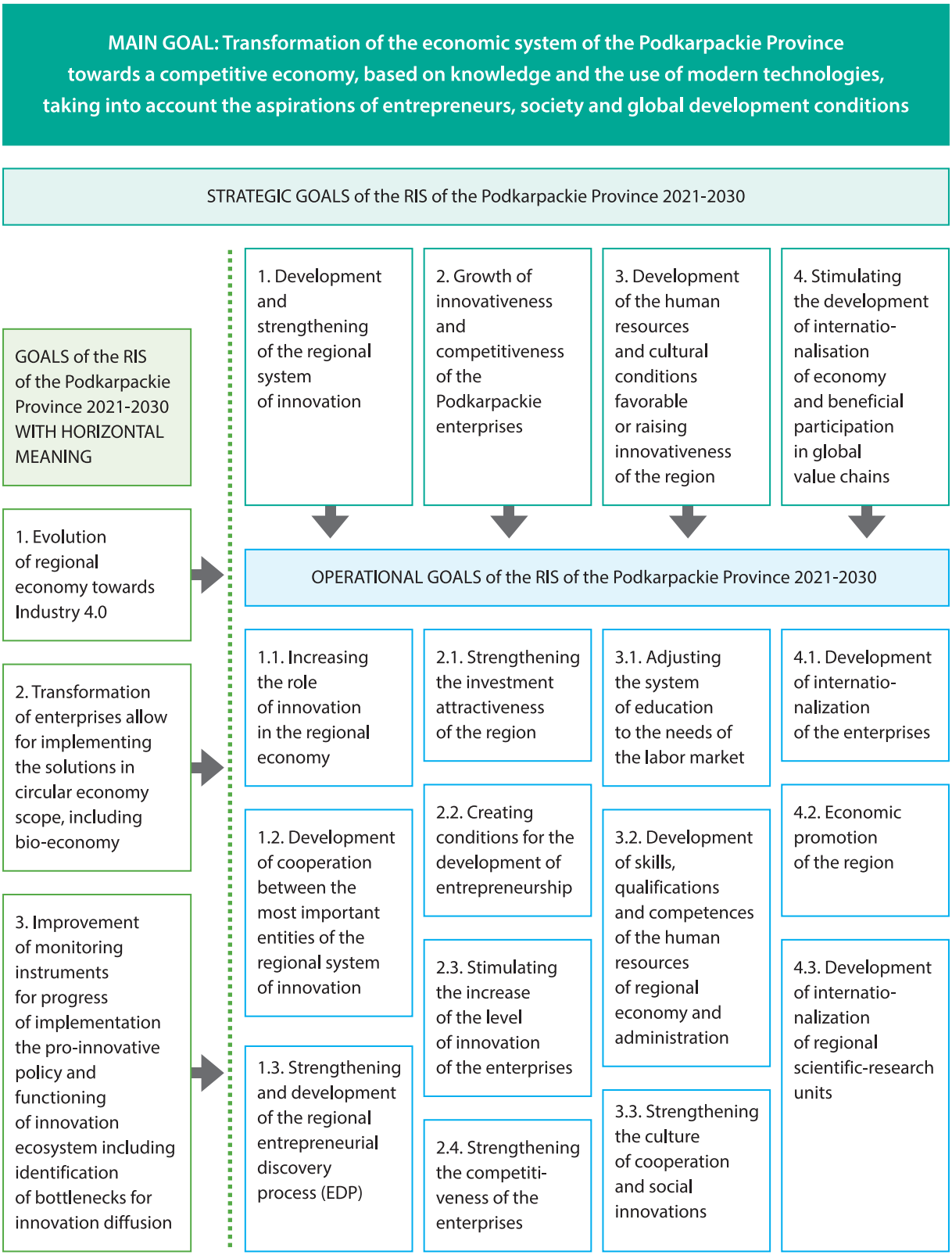
The Podkarpackie Province is a region with an ecological, socially sustainable, innovative and competitive economy, which effectively competes with other centers in Poland, Europe and the world, ensuring a friendly climate for the development of entrepreneurship. It is a region conducive to creating innovation, efficiently using endogenous resources and competitive advantages, and providing an excellent place to work and relax.

Achieving such a vision will require active participation of all stakeholders of the Podkarpackie innovation system in the implementation of the RIS of the Podkarpackie Province. A special role in this respect will fall to the Local Government of Region as the leader of this system. At the same time, it will be responsible for the implementation of the mission presented below:

The Podkarpackie Province is a region that uses the innovative and competitive potential and is an attractive place to live and work.

In the course of work on the RIS of the Podkarpackie Province, the main goal and strategic goals were indicated, both of operational, as well as horizontal nature, the implementation of which will allow to achieve the previously formulated visions and missions. Their layout is presented in the figure on page 133.

Figure 33. Layout of the goals of the RIS of the Podkarpackie Province



Source: own study

The first strategic goal will serve to build and strengthen the innovation system, and the individual elements of the quadruple helix forming it. Achievement of this goal will be possible thanks to the implementation of the three operational goals:

1. Increasing the role of innovation in the regional economy – it will serve the creation of the innovation potential in the region, including the scientific-research units and institutions of the business surroundings;
2. Development of cooperation between the most important entities of the regional system of innovation – will allow to build and strengthen the already existing links between the stakeholders of the regional innovation system;
3. Strengthening and development of the regional entrepreneurial discovery process (EDP) – its task is to constantly improve the regional innovation system by monitoring its operation in order to identify possible gaps, new tasks not yet managed by the participants of the system, potential new participants or areas of the economy that are important for its development.

The second strategic goal focuses on comprehensive support for the development of the enterprises from the Podkarpackie Province. Its implementation will be served by four operational goals:

1. Strengthening the investment attractiveness of the region – it is to enable the creation of a optimal conditions for the emergence of new and development of existing investments in the region;
2. Creating conditions for the development of entrepreneurship – will focus primarily on providing the conditions necessary to raise the level of entrepreneurship in the region;
3. Stimulating the increase of the level of innovation of the enterprises – the goal covers all areas affecting the innovativeness of Podkarpackie enterprises;
4. Strengthening the competitiveness of the enterprises – the implementation of the goal is to build the competitive potential of Podkarpackie enterprises, including those representing industries with a lower degree of innovation.

The third strategic goal is to build human resources (including scientific staff) and social resources in the Podkarpackie Province, responding to current and future challenges of the labor market, as well as supporting the development of innovation in the region. Achieving this goal will be possible thanks to the implementation of three operational goals:

1. Adjusting the system of education to the needs of the labor market – this goal focuses on activities related to the education of future staff at all levels of education, which enables graduates to find their place in the labour market;
2. Development of skills, qualifications and competences of the human resources of regional economy and administration – focuses on areas related to the development of human resources through participation in various forms of further education (extracurricular, continuing, postgraduate education, etc.);
3. Strengthening the culture of cooperation and social innovations – the aim is to build regional social capital, including primarily in areas related to innovation.

The fourth strategic goal focuses on areas related to empowerment of the Podkarpackie Province on international markets. This will be possible thanks to the implementation of three operational goals:

1. Development of internationalization of the enterprises – the goal focuses on areas related to support Podkarpackie enterprises in establishing and strengthening international cooperation;
2. Economic promotion of the region – focuses on activities related to strengthening of the recognition of the province on the international arena;
3. Development of internationalization of regional scientific-research units – this will serve the development of international cooperation undertaken by scientific and research units in the Podkarpackie Province.

In addition, three horizontal goals affecting all areas of the economy have been identified:

1. Evolution of regional economy towards Industry 4.0 – the goal will focus on activities aimed at popularizing the use of Industry 4.0 solutions;
2. Transformation of enterprises allow for implementing the solutions in circular economy scope, including bio-economy – includes areas related to raising awareness of the circular economy, as well as to the more widespread use of circular economy models in the activities of enterprises in the Podkarpackie Province;
3. Improvement of monitoring instruments for progress of implementation the pro-innovative policy and functioning of innovation ecosystem including identification of bottlenecks for innovation diffusion – will focus on areas related to monitoring the functioning of the regional innovation system, concerning both the development of smart specialisations, as well as areas of significant importance for the economic development of the province.

The goals of RIS of the Podkarpackie Province will fit into both the scope of the Strategy for the Responsible Development and the Enterprise Social Responsibility. They are also complementary to the main directions of intervention indicated in the Productivity Strategy, in particular:

- optimization of the management of non-renewable raw materials with particular emphasis on their quality, value and reusability;
- increase of the sustainable use of renewable resources in industry;
- adaptation of the competences to the challenges of the future;
- the development of modern lifelong learning;
- digital transformation of enterprises;
- improvement of the functioning of private institutions to build trust and cooperation;
- strengthening the process of generating knowledge and technology;
- improvement of the process of knowledge diffusion;
- development of artificial intelligence technologies and their implementation in key areas of the economy and state;
- universal access to a fast and reliable data transmission infrastructure;
- foreign expansion[189].

[189] *Projekt Strategii Produktywności 2030*, Warsaw 2020, s. 36-147.

The structure of the individual goals of the RIS and the identified actions to achieve them have been shown in the table below.

Table 10. Tree of strategic goals of the RIS of the Podkarpackie Province 2021-2030

Main goal: Transformation of the economic system of the Podkarpackie Province towards a competitive economy, based on knowledge and the use of modern technologies, taking into account the aspirations of entrepreneurs, society and global development conditions	
Strategic goal 1: Development and strengthening of the regional system of innovation	
Operational goals	Proposed implementation activities
1.1. Increasing the role of innovation in the regional economy	Support for the development of institutions providing pro-innovation services for the enterprise sector
	Professionalization of innovation centre services and increasing their potential
	Support for the process of knowledge and technology transfer
	Support for the transfer of operating standards between large enterprises and SMEs, exchange of good practices and knowledge, and partnership creation of innovations for the development of smaller companies and Polonization of supplies
	Strengthening intellectual property protection activities
	Development of R&D activity of scientific units
	Development of the commercialization system for the results of R&D works in scientific units
	Support for the growth of the ability of research sector entities to create and commercialise knowledge, in particular in the areas of regional smart specialisations
	Support for the development of R&D activities in areas outside regional smart specialisations
1.2. Development of cooperation between the most mportant entities of the regional system of innovation	Support for the creation and development of clusters and cluster initiatives, especially in the areas of smart specialisation and 'aspiring' industries
	Support for the creation and development of cooperative links
	Strengthening cooperation between scientific and research institutions and business
	Activation of networking cooperation between all entities creating a regional innovation system
	Creation of the incentive mechanisms to initiate and conduct cooperation in the enterprise sector and between enterprises and the science sector
	SME networking support
	Support for activities strengthening institutional (mainly business) links within common value chains

1.3. Strengthening and development of the regional entrepreneurial discovery process (EDP)	Activation and expansion of the group of participants in the entrepreneurial discovery process
	Improvement of instruments for identifying new key industries, economic niches or technologies
	Support for the search for technologies combining various industries of economy
Strategic goal 2: Growth of innovativeness and competitiveness of the Podkarpackie enterprises	
Operational goals	Proposed implementation activities
2.1. Strengthening the investment attractiveness of the region	Creation and development of zones of concentration of economic activity
	Stimulation of the creation and development of industrial parks and technological centres, centres of entrepreneurship and innovation, and growth of their potential
	Ensuring the supply of investment areas prepared for conducting business activity
	Support for investment processes and attracting investors
2.2. Creating conditions for the development of entrepreneurship	Support for the creation and development of pre-incubators, business incubators and other forms of assistance in starting a business (e.g. virtual office) and the development of the potential of these institutions
	Creation and development of start-up projects
	Support for the development and scaling of SMEs
	Support for investments in the construction of R&D infrastructure in enterprises
	Support for the development of institutions providing basic services to enterprises
	Creation of conditions for the development of interregional cooperation
	Adaptation of support instruments (including financial support) to the needs and potentials of industries, economic entities (beneficiaries) and geographical areas of operation
	Strengthening the capacity of public institutions to create conditions for the development of entrepreneurship
2.3. Stimulating the increase of the level of innovation of the enterprises	Strengthening the conduct of R&D activities and its effects in enterprises
	Creation and development of incentive mechanisms to increase the level of innovation of enterprises, including in the SME sector
	Support for the development and implementation of new technologies, patents, industrial and utility designs
	Creation and development of spin-off and spin-out companies
	Activation of the implementation of innovative solutions in 'traditional' branches of the economy
	Intensification of the 'green technologies' usage in the enterprises of the region, in particular in the areas of smart specialisation
	Support for undertaking cooperation in the field of innovative activities by enterprises

2.4. Strengthening the competitiveness of the enterprises	Boosting action to shorten supply chains
	Creation and development of incentive mechanisms to raise the level of competitiveness of enterprises
	Support for the development and implementation of solutions that increase the competitiveness of enterprises
	Strengthening the recognition of regional products, brands, especially in the area of smart specialisations
	Provision of basic and specialised services to enterprises
	Support of business growth by increasing access to financial services and integration into value chains
	Formation of the resilience of enterprises to the effects of emerging economic crises
Strategic goal 3: Development of the human resources and cultural conditions favorable or raising innovativeness of the region	
Operational goals	Proposed implementation activities
3.1. Adjusting the system of education to the needs of the labor market	Development of an educational offer corresponding to the needs of industries and professions of the future
	Support for cooperation between enterprises and the education system in the field of employee training at all levels of education
	Development of a system for monitoring and analyzing trends in the field of labour market needs
3.2. Development of skills, qualifications and competences of the human resources of regional economy and administration	Inspiration to the discovery of professional predispositions, shaping interests and developing the competences of the future (technical and digital, social and higher cognitive competences, including key professional competences[190]) in formal, informal and non-formal education and lifelong learning
	Support for actions aimed at counteracting premature leaving of the labour market by the employees
	Support for the system of improving professional qualifications and competences by scientific and research staff and teachers, especially teachers of vocational schools
	Rinforcement of the employee potential of the university, including the implementation of incentive systems for continuing scientific work for the most talented graduates
	Support for the process of improving the qualifications and competences of employees (including scientific personnel) through scholarship programmes
	Increase of the scientific potential of enterprises by supporting scientific publications in renowned scientific journals

[190] Kluczowe kompetencje przyszłości wskazane zostały w raporcie Future Work Skills z 2020 roku opracowanego przez Institute for the Future, https://www.iftf.org/uploads/media/SR-1382A_UPRI_future_work_skills_sm.pdf [access 02.04.2021].

	Development of pro-entrepreneurial attitudes and raising the level of self-employment
	Stimulation of the development of lifelong learning and raising public awareness of its importance
	Development of the training offer in the field of lifting/changes in professional qualifications and competences
3.3. Strengthening the culture of cooperation and social innovations	Building social capital in the process of creating and implementing the RIS of the Podkarpackie Province and promoting this process as a good practice of cooperation for innovation in the region
	Promotion of the value of knowledge and creativity among children and youth
	Taking action in the field of 'citizen science'
	Popularization of science, technology and innovation
	Promoting pro-innovation attitudes
	Support for the creation and development of local innovation systems and local knowledge systems
Strategic goal 4: Stimulating the development of internationalisation of economy and beneficial participation in global value chains	
Operational goals	Proposed implementation activities
4.1. Development of internationalization of the enterprises	Reinforcement of the level of export of enterprises from the Podkarpackie Province
	Support for the export of innovative products/technologies
	Support and promotion of regional participation of the companies in the international value chains
	Activation of the participation of regional enterprises in the international innovation projects
	Support for the development of the level of internationalization of cluster activities
4.2. Economic promotion of the region	Organization of events in the region, economic missions of international scope
	Support for the promotion of regional brands in the arena of international cooperation
	Increase of the presence of the region (Podkarpackie Province) in international initiatives/projects building a framework for cooperation in the areas of R&D and support for entrepreneurship
	Intensification of information and promotion activities in the field of innovation undertaken outside and inside the region
4.3. Development of internationalization of regional scientific-research units	Increase of the activity of regional research units in cooperation networks and international thematic platforms
	Promotion and support of th international cooperation of the universities and research organisations
	Creation and development of mechanism encouraging the international cooperation of the regional scientific-research units

Horizontal strategic goals	
Goals	Proposed implementation activities
Horizontal goal 1: Evolution of regional economy towards Industry 4.0	Support for the development of infrastructure for digital technologies
	Creating the conditions to increase the share of digital technology in core business, including customer service
	Development of modern methods of communication and diagnostics of industrial objects
	Improvement of industrial processes related i.a. with design, production, material management and supply chain
	Support for the design, creation and development of smart factories and products
	Intensification of development and implementation of solutions in the field of automation and robotization of technological and management processes
	Support for the equipment of scientific and research units in the infrastructure and equipment necessary for active participation in knowledge exchange networks between the main research centres
	Support for the development of e-government and cybersecurity
	Widespread use of technology, including information and communication technologies
Horizontal goal 2: Transformation of enterprises allow for implementing the solutions in circular economy scope, including bio-economy	Support for the transition of production from linear to circular
	Improving processes for extending the life cycle of products
	Creating incentive mechanisms for the implementation of effective circular economy solutions in enterprises
	Support for raising specialist knowledge in the field of circular economy
	Dissemination of the use of technologies and processes in the field of circular economy
	Measures to increase the use of renewable energy sources
	Support for the creation and implementation of sustainable models of consumption and production
Horizontal goal 3: Improvement of monitoring instruments for progress of implementation the pro-innovative policy and functioning of innovation ecosystem including identification of bottlenecks for innovation diffusion	Implementation of cyclical reports monitoring the progress of implementation RIS of the Podkarpackie Province 2021-2030
	Implementation of detailed research on the functioning of the innovation system in the Podkarpackie Province

Source: own study

7 Management of the innovation system in the Podkarpackie Province

7.1 Entities involved in the implementation and realization of the RIS of the Podkarpackie Province and their role in the innovation system

In the process of implementation and realization of the RIS of the Podkarpackie Province, the entities forming the regional innovation system that will allow effective use of human, organizational and financial resources, active cooperation of all stakeholder groups of the Strategy, undertaking activities aimed at strengthening the innovativeness of the region taking into account the principles of sustainable development, as well as monitoring and evaluation of the effectiveness of the activities undertaken.

The regional innovation system is understood as "a system of links and cooperation between partners, such as enterprises, universities, research, training, advisory and local government institutions, as well as economic local governments and other business organisations, thanks to which innovation is increased"[191]. CRS 2030 stresses the need for inclusion in the process of effective implementation of regional policy for local government units as well as entrepreneurs, scientists and civil society[192]. In order to achieve this objective, close cooperation between all these actors will be necessary.

The innovation system of the Podkarpackie Province is intended to perform organizational, driving (which means starting and enabling the implementation of development processes), monitoring, evaluation, information and educational functions. Its important element is financial support for activities aimed at increasing innovation and competitiveness of the region and creating conditions for multifaceted cooperation.

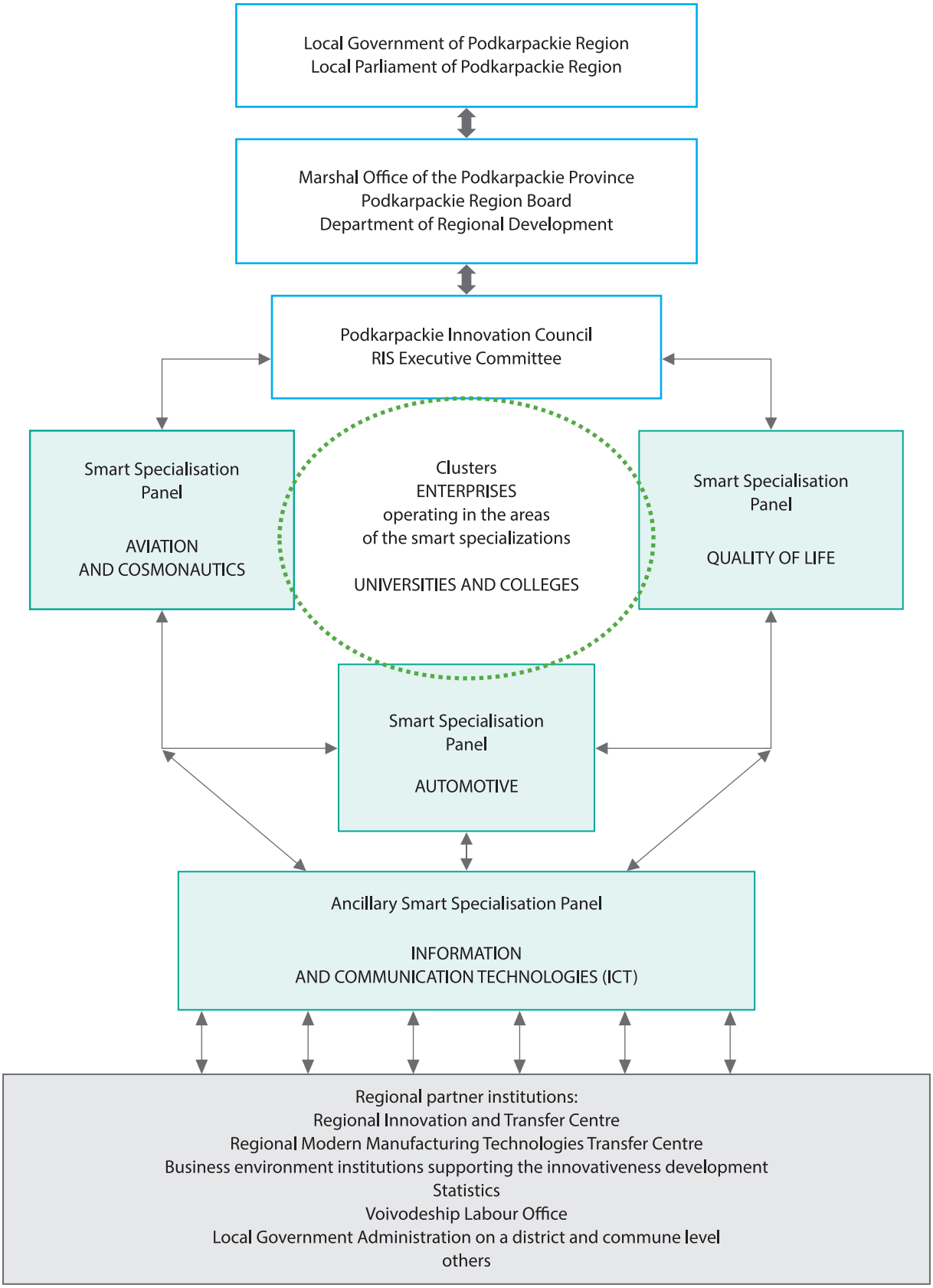
The functioning of the innovation system in the Podkarpackie Province is based on the quadruple helix model. According to this concept, various stakeholder groups are involved in the process of creating innovation: entrepreneurs, representatives of the science sector, administration, as well as broadly understood civil society. It should also be noted that an important role for the functioning of the regional innovation system is played by business environment institutions, which are somehow at the interface of all four stakeholder groups[193].

[191] Report from the study *Przegląd i analiza regionalnych systemów innowacji województw Polski w kontekście przygotowań do realizacji europejskiej polityki spójności po 2013 roku* carried out by B. Plawgo, T. Klimczak, P. Czyż, R. Boguszewski, A. Kowalczyk in 2013 on behalf of the Polish Agency for Enterprise Development, Warsaw 2013, p. 138, http://www.parp.gov.pl

[192] *KSRR 2030*, p. 40.

[193] *System innowacji*…, op. cit., pp. 23-24.

Figure 34. Podkarpackie System of Innovation defined in RIS3



Source: *Regional Innovation Strategy of the Podkarpackie Voivodship for smart specialization 2014-2020*

According to the quadruple helix concept, society plays an important role in the processes of creating innovations, which creates innovations that are important to it and is the driving force behind the innovation process. Public authority, on the other hand, creates conditions for dialogue and provides tools for the development of innovation. Other important elements of the innovation system are R&D units, which are primarily to support the pro-innovative activity of society and participate in the process of implementing innovation together with the administration and enterprises. Entrepreneurs, in turn, commercialize innovative solutions by manufacturing products and providing services based on innovative solutions. However, the most frequently mentioned entities need support from business environment institutions that facilitate cooperation and dialogue and participate in the processes of knowledge transfer[194].

Building and improving the innovation system in the Podkarpackie Province is a process carried out since the adoption of the first innovation strategy. Its leader was the Local Government of Podkarpackie Region carrying out its tasks through the Podkarpackie Region Board.

The process of building the innovation system will also continue during the implementation and the realization of RIS of the Podkarpackie Province 2021-2030.

The innovation system of the Podkarpackie Province currently has a very extensive list of entities forming its structure, which gives little possibility to introduce new elements[195]. RIS of the Podkarpackie Province makes the necessary adjustments to ensure smooth functioning of the system. It will be created by the following entities:

1. Enterprises sector:
   - Entities providing basic and specialised services for enterprises;
   - Other enterprises.

2. Science sector:
   - Universities and colleges;
   - Centres for Technology Transfer;

3. Sector of administration:
   - Local Government of Region (including the Podkarpackie Region Board with the help of Departments of the Marshal Office of the Podkarpackie Province);
   - Podkarpackie Science Center 'Łukasiewicz';

[194] According to the provisions of the *Strategii na Rzecz Odpowiedzialnego Rozwoju*, the reasons for the low innovativeness of the economy may lie in the environment of enterprises and the attitudes of entrepreneurs towards cooperation. It is necessary to modify the legal and institutional environment so as to stimulate risky innovative activities. There is also a need for proper coordination of activities and support instruments at the national and regional level and for creating conditions conducive to building trust and real cooperation in the innovation process, because the low willingness of companies to cooperate with other entities (business as well as with the world of science) has a significant impact on their innovation. Ineffective communication between science and business and inadequate cooperation in the area of innovative activity may result in insufficient market potential of conducted research, low interest of entrepreneurs in the research works of the world of science and their results, and consequently a preference for implementing ready-made solutions. In the context of eco-innovation, an additional barrier is the low awareness of producers in terms of the benefits associated with their implementation in the form of savings – lower costs of doing business.. *Strategia na Rzecz Odpowiedzialnego Rozwoju do roku 2020 (z perspektywą do 2030 r.)*, p. 87.

[195] *System innowacji*…, op. cit., pp. 20-21.

- Voivodship Labor Office in Rzeszów;
- Self-government of the Commune, Poviate;
- Business environment institutions (including: RARR, PCI, PFR Sp. z o.o., MARR, TARR, etc.), which fit not only into the administration sector, but also into the enterprise or society sector;
- Poviate Labor Offices;
- Statistics Rzeszów;
- State agencies and institutions (i.a. PARP, ARP, SSE, NCBiR, PFR);
- Central Administration Bodies (i.a. Statistics Poland, Education Supervisors, Central Office of Measures, Treasury Administration);

4. Society:
   - Clusters;
   - Industrial-Commercial Chamber, Economic Chambers;
   - Podkarpackie Regional Tourism Organization;
   - Local Action Groups;
   - Other non-governmental organizations;
   - Economic self-governments and other organisations of the enterprises;
   - Schools and centers of culture;
   - Informal groups, local communities, popularising entities.

Entities are not only co-participants in the innovation system, they are also co-responsible for its effective functioning. Each of the above elements – due to its different specificity, as well as different potential, implements specific activities that have been indicated in the following subsections.

7.1.1 Local Government of Region as a leader of the innovation system of the Podkarpackie Province

In the *Regional Innovation Strategy of the Podkarpackie Voivodeship for smart specialization 2014-2020*, the role of the system leader in Podkarpackie Province was assigned to the Local Government of Region. High awareness of the Local Government about the function, what innovations play in creating the development of the region's economy and the involvement of the Podkarpackie Region Board allowed us to build and constantly improve the structure of the innovation system. It is an entity that consistently creates and adapts the innovation system to current challenges, achieving above-average results measured by the increase in innovation and competitiveness of the Podkarpackie Province.

Both the Act on the Local Government of Region and the System of Managing the Development of the Country impose on this body tasks related to the creation of the region's development policy, including responsibility for the preparation of the most important regional strategic and programming documents, such as the Regional Development Strategy or development programmes for its implementation (e.g., RIS of the Podkarpackie Province). In carrying out these tasks, the Local Government conducts a policy of economic development of the region, which focuses on areas related to:

- Strengthening research and development activities carried out in the region, in particular in areas supporting the development of smart specialisations of the region;

- Strengthening cooperation between the science and business sectors in order to focus research on issues arising from the needs of entrepreneurs;
- Strengthening the broadly understood innovativeness of enterprises, including in particular industries representing smart specialisations of the region;
- Supporting the development of competitiveness of more traditional branches of the regional economy, e.g. tourism;
- Support for Podkarpackie enterprises in creating and joining value chains.

The Local Government of Region, whose executive body is the Podkarpackie Region Board, implements tasks related to the functioning of the regional innovation system with the help of the Departments of the Marshal Office of the Podkarpackie Province, including primarily through the Department of Regional Development, responsible for the preparation and implementation of the Regional Innovation Strategy. In addition, among other institutions, the following bodies will be involved in the implementation of the RIS of the Podkarpackie Province: the Department of Regional Operational Programme Management and the Department of Entrepreneurship Support as responsible for the development and implementation of the ROP of the Podkarpackie Province, the Department of Promotion, Tourism and Economic Cooperation, the Department of Regional Economy and the Department of Rural Development Programme.

The Local Government of Region undertakes numerous activities aimed at supporting the development of innovation in the region. They include, for instance:

- Establishment of the Podkarpackie Innovation Council, which includes representatives of various stakeholder environments: business, science, local government and regional government administration, and regional innovation experts. The Council acts as an opinion-giving and advisory to the Podkarpackie Region Board in the field of both the implementation of the Regional Innovation Strategy, as well as in identifying and supporting innovative projects or networking cooperation. It also enables cooperation with other elements of the quadruple helix, i.e. the enterprise, science and society sectors;
- Organizing Smart Specialisation Panels, implemented as part of the Entrepreneurial Discovery Process and performing the functon of the meetings allowing the exchange of knowledge and experience and strengthening cooperation between stakeholders linked to regional smart specialisations. The panels are also a place of cooperation between the SS stakeholders and local authorities in order to develop directions for the development of specialisation and the selection of appropriate support instruments;
- Organizing Podkarpackie Innovation Forums, which are platforms for dialogue targeting individual smart specialisations;
- Functioning of the Podkarpackie Investor and Exporter Service Center (COIiE) – a unit operating in the structure of the Department of Regional Development of the UMWP, dealing with free support for enterprises in the search for new foreign markets (pro-export service), as well as assistance to foreign companies in starting a business in the Podkarpackie Province (pro-biz service);
- Implementation of own projects financed from EU funds:
  1. *Smart specialisations – a tool for increasing the innovation and competitiveness of the Podkarpackie Province*, enabling the performance of tasks related to the Entrepreneurial Discovery Process;

2. *Economic promotion of the Podkarpackie Province*, under which entrepreneurs can obtain support for participation in the international fairs and economic missions;
3. *Podkarpackie Business Support Platform*, which aims to support the SME sector in gaining access to specialized business-related services;

- Creation and operation of the RSI portal, i.e. an informational website where RIS programme and monitoring documents are made available and where studies and analyses created in connection with the implementation of the Regional Innovation Strategy, as well as news on organized economic events or the activities of the Local Government of Region pertaining to RIS3 are published[196].

On the initiative of the Local Government of Region, institutions were also created, which as entities offering a wide range of services supporting the development of the enterprise and science sectors are an important element of the innovation system of the Podkarpackie Province. These institutions include:

- Rzeszów Regional Development Agency in Rzeszów (Podkarpackie Region) carries out a number of tasks in the field of supporting the development of entrepreneurship both through the management of the Podkarpackie Science and Technology Park 'Aeropolis', as well as by providing basic and specialized services for business;
- Podkarpackie Centrum Innowacji Sp. z o.o. (PIC), whose activity concentrates on combining the education with business and on the development of the key skills among reserchers and administrative staff. This is carried out by organizing conferences and trainings, but also awarding grants for research projects or creating a regional network of laboratories under the name Podkarpackie Network of Research and Calibration Laboratories[197];
- Podkarpacki Fundusz Rozwoju Sp. z o.o. (PFR Sp. z o.o.) [Podkarpackie Development Fund], focused on stimulation of the economic activity through financial support mainly in the form of loans. The Fund offers support to the small and medium-sized enterprise sector, in particular to companies that have difficulties in accessing financing. Its task includes also strengthening creativity of investment activity of the economic entities from the provice, facilitating them the access to external sources of financing. The company acts mainly as the loan fund, granting loans and credits to companies, but also offers such instruments as factoring and sureties.[198]

The Regional Government also initiated the construction of the Podkarpackie Science Center 'Łukasiewicz' (PSC). Thanks to its functioning, the inhabitants of the region will be able to explore the secrets of knowledge, also in areas that constitute smart specialisations. PSC 'Łukasiewicz' will be actively involved in the popularization of knowledge about the determinants of the quality of life of society. The Center will also disseminate and popularise the innovativeness among the society. This may result in greater openness to technical and technological progress and openness to innovative solutions. This will make a significant contribution to the creation of social and human capital for the needs of the regional innovation system.

196 *System innowacji*…, op. cit., p. 40.
197 https://pcinn.org/ [access 01.08.2020].
198 https://www.pfr-podkarpackie.pl/ [access 01.08.2020].

The Voivodship Labor Office in Rzeszów (VLO) is also one of the units subordinate to the Local Government of Region. Its tasks within the Podkarpackie innovation system will focus mainly on strengthening the regional staff potential (including support in adapting the educational offer to the needs of the labor market, improving the competences of staff, self-employment, as well as consulting for entrepreneurs, the unemployed or professionally disadvantaged and information on the possibilities of improving qualifications or retraining). Voivodship Labor Office will also undertake activities aimed at supporting entities providing services to strengthen their human resources capacity (i.a. training services and educational ones). In addition, it will implement activities in the area of entrepreneurship, in particular, supporting its development (understood here as analytical, information or advisory services).

Taking into account the previous function of the Local Government of Region as the entity responsible for creating the policy of supporting the innovativeness, initiating and raising cooperation between the elements of the innovation system as well as (as the Managing Institution for the ROP of the Podkarpackie Province) for delivery of the instruments of the support for the innovativeness development, also in Regional Strategy of Innovativeness of the Podkarpackie Province for the years 2021-2030 will fulfill the role of the leader and coordinator of the system. During the implementation and realization of RIS of the Podkarpackie Province, the Local Government of Region will be responsible for performing many tasks in all areas important for the development of competitiveness and innovation of the Podkarpackie economy, i.e., entrepreneurship, as well as science (including R&D activities) and the labor market, which are simultaneously in line with the strategic and horizontal objectives of the RIS of the Podkarpackie Province. Actions to implement them will be undertaken not only directly by the Local Government, but also by the institutions established by it, primarily including RARR, PIC, PFR and PSC.

The tasks of the Local Government of Region in the area of entrepreneurship consist not only in providing financial support to entrepreneurs. It is also responsible for creating the conditions for the development of the entrepreneurship in the region, by means of, inter alia, preparation of the areas for the investment and making available them for the investors, construction of the infrastructure, which then is used by the entrepreneurs or granting the financial support for the equipment of the premises to conduct the business activity.

The authorities of the province will also be responsible for the implementation of tasks related to stimulating the development of entrepreneurship, consisting in supporting the creation of and the functioning of the enterprises themselves. These tasks will include initiating and developing start-up initiatives, establishing and strengthening cooperation between the business sector and science, activating cooperation by entrepreneurs (in the form of e.g. cluster initiatives) and internationalization of enterprises, providing investment support for entrepreneurs, attracting external capital, offering technical support, supporting the implementation and development of innovations or certification of technologies, solutions and products, as well as their transfer to other entities, as well as enabling or supporting the development of Business environment institutions providing services to e.g. the corporate sector. The Local Government of Region supports the growth of the level of entrepreneurship by creating conditions for the development of a knowledge-based economy and supporting industrial transformation towards Industry 4.0 and the circular economy. It also

creates the conditions for developing and strengthening interregional and international cooperation through the establishment of a variety of partnerships.

The last important group of tasks undertaken in the area of entrepreneurship are services supporting its development. Local Government of Region in their realization will include in double manner – by means of provision of services for the entrepreneurs (including basic and specialist services) by its institutions but also in the form of providing the financial support for the provision of these services by other entities.

The Local Government of Podkarpackie Region is also involved in the implementation of tasks related to the development of the science sector. To raise the level of innovativeness of enterprises from the Podkarpackie Region and at the same time for the economic development of the region, the activity of the research and scientific enterpises and their cooperation with the sector of the business in the area of the development and implementation of innovative solutions, technologies or products have a significant importance for the economic decelopment of the region. Therefore, the activities will be undertaken to provide support in the scope of the investment in the research and development infrastructure or conducting the research and scientific activity, commercialize the results of scientific research, transfer the knowledge and technology from the research units to the sector of enterprises, undertake cooperation by the schools and scientific units, develop academic entrepreneurship as well as to provide the analytical and research-developmental services for both business and education sectors. Activities related to enablement of the improvement of qualifications of scientific staff or popularization of science, technology and innovation, as well as the development of 'citizen science' are also important. Services aimed at strengthening the development of the R&D sector, including basic and specialised services provided for the needs of this sector, will also be supported.

RIS of the Podkarpackie Province (contrary to the previous strategies) emphasises the meaning of the labor market and education of the staff for the economic development of the province. Therefore also within the process of implementation of the strategy the activities ill be conducted directed at development of the staff potential (including: adjusting the educational offer for the purposes of the employers; improving the competence of the staff as well as aiming at self-employment or advisory for the entrepreneurs, unemployed or persons without professional preferences), as well as supporting the provision of services aiming at strengthening the potential.

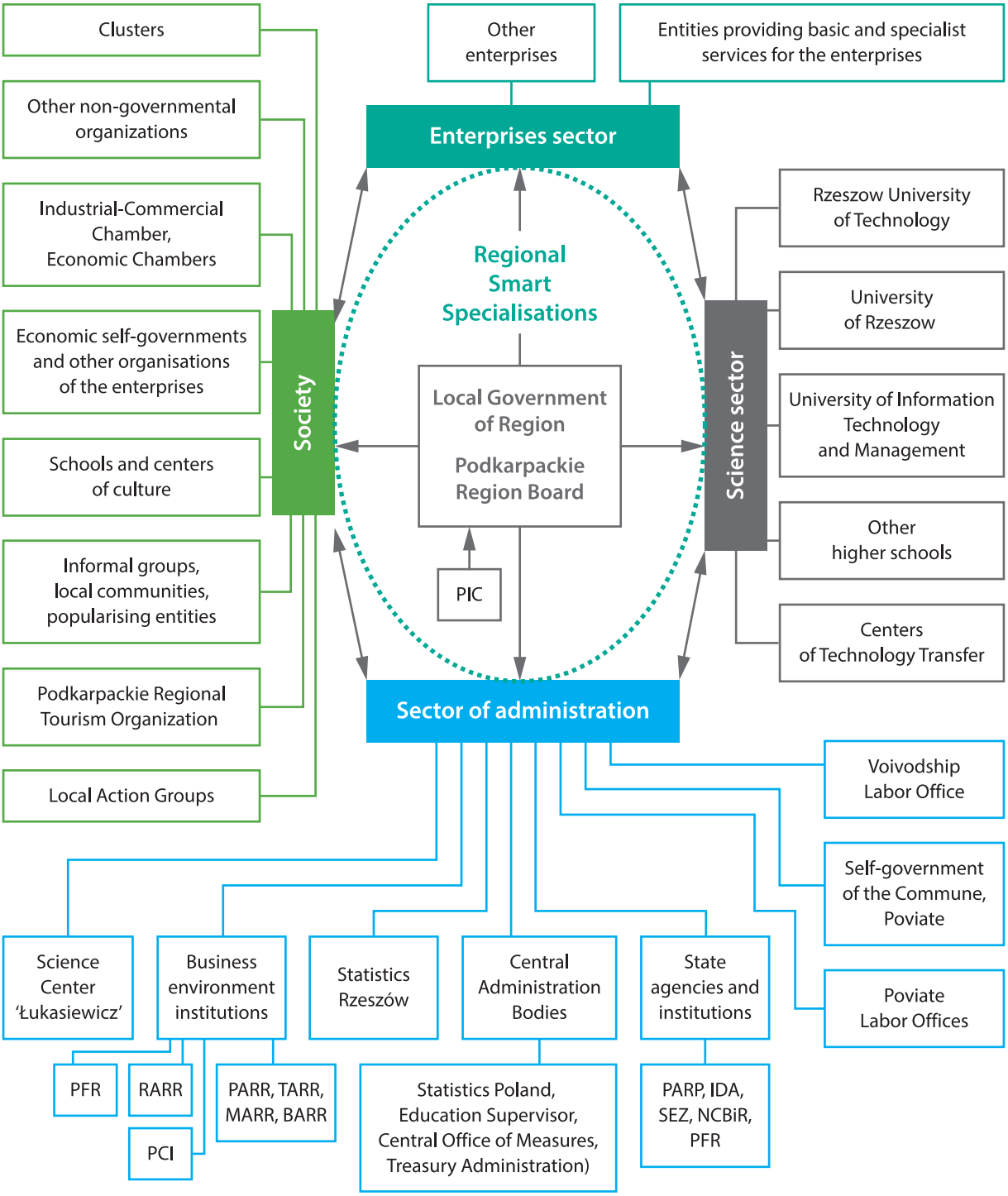
The Local Government of Podkarpackie Region is not able to independently carry out such an extensive catalog of tasks, which is why it is extremely important to actively cooperate with the leader of the innovation system with the individual constituent elements of the quadruple helix.

7.1.2 Elements of the quadruple helix forming the innovation system of the Podkarpackie Province

The most important factor supporting the functioning and development of the system of innovation is active cooperation between the entities, creating its structure. In addition to cooperation with the Local Government of Region as the leader of the system, there must also be relations between the quadruple helix sectors. During the work on the preparation of the RIS of the Podkarpackie Province,

identification was made of the stakeholders involved in its implementation. Their structure and the relationships between them are presented in the figure below.

Figure 35. The innovation system of the Podkarpackie Province identified under the RIS of the Podkarpackie Province 2021-2030



Source: own study

7.1.2.1 Enterprises sector

One of the important components of the system of innovation are the enterprises which constitute the center of the process of creation and development of innovation. Business, responding to the needs of citizens, supports the innovation process by providing appropriate tools (both in the form of financial resources for innovative and non-financial activities). Companies are also often the initiator of this process by creating demand for an innovative product.

The enterprise sector, which is one of the elements of the quadruple helix forming the innovation system of the Podkarpackie Province, consists of both manufacturing and industrial enterprises with high innovation potential, but also service enterprises in which it is more difficult to find innovative products or solutions, including enterprises providing basic and specialized services to other entities, supporting the development of their innovation and competitiveness. The scope of their activities undertaken as part of the implementation and implementation will also be different RIS of the Podkarpackie Province.

Enterprises providing the basic and specialist services for other enterprises will be responsible first of all for strengthening the sector of the enterprises in the Podkarpackie Province by means of, inter alia, realization of the tasks in the scope of the advisory, performing analyses and activities, providing information and aid in the scope of possibility to obtain financial support for the development of the activity of the enterprises or making activities in the scope of personnel improvement. In addition, they will perform a number of specialized services for the needs of entrepreneurs, aimed at strengthening their competitiveness and innovation.

The scope of tasks of other enterprises covers almost all areas identified as part of the RIS of the Podkarpackie Province implementation system. In particular their activity in the scope will refer both the activity Research and development as well as undertaking and strengthening the cooperation on domestic and international level.

The enterprises of the Podkarpackie Province actively cooperate with other sectors included in the composition of the innovation system. In order to increase productivity and increase competitiveness, Podkarpackie companies cooperate with each other by e.g., creating cluster structures (often in the form of associations), enabling the transfer of knowledge, experience, facilitating the establishment of business contacts both at home and abroad, or creating and participating in supply chains.

Podkarpackie enterprises also cooperate with the administration sector not only as a service provider or recipient, but also as partners of the Entrepreneurial Discovery Process carried out as part of the implementation of the Regional Innovation Strategy, through i.a. participation in the work of the Podkarpackie Innovation Council or Smart Specialisation Panels.

Cooperation of the enterprises with the sector of education is conducted two-way. Business is one of the more important sources of financing R&D activity conducted by the Podkarpackie universities. It is also one of the main recipients of the effects of the activity. The enterprises cooperate also with schools and vocational school in the scope of staff education, whose ualifications and competences will correspond to the needs reported by the employers.

7.1.2.2 Science sector

Science sector in the system of Podkarpackie Province innovation consists of both universities and schools as well as centers of technology transfer (CTT). Involvement of all schools and research-scientific units in Podkarpackie Province in the system of innovation is not limited only to conducting the didactic activity or conducting research commissioned by the business entities. The schools show high activity in realization of their own research-scientific projects the results of which may be then commercialised. In the area of development of activities of entrepreneurship, CTT will implement a much more tasks of that kind. In particular, they latter will include tasks related to the implementation and development of innovations, certification of technology solutions, products, technology transfer or cooperation with Business environment institutions. CTT also provide the information and advisory services for the enterprises. The university's activities in this area will focus both on cooperation with the enterprise sector in the field of implementation and development of innovations, certification of innovative products or solutions, technology transfer, provision of research and analytical services, as well as development of the knowledge-based economy and support for industrial transformation towards Industry 4.0 or the circular economy.

For obvious reasons the highest activity of all entities creating up the science sector within the innovation system of the Podkarpackie Province shall concentrate in the area of education including R&D sector. It will include not only organization and conducting research-developmental works but also security for the intellectual property for the technologies developed, products of utility models. The entities included in the sector shall also join educational activities connected with 'citizen education' or the education popularization. An important task within this area is also to support and stimulate their own scientific staff to improve their qualifications and competences by the authorities of universities and research and scientific units. The science sector will also be responsible for undertaking activities in the area of improving the qualifications and competences of staff for the needs of the labour market, including primarily for conducting educational services or adapting the educational offer to the needs reported by potential employers

The implementation of these tasks requires active cooperation of the science sector with other elements of the quadruple helix, also with other universities and scientific units. That is why universities anc colleges in the Podkarpackie Region are building networks of partnership not only in the region or country, but also on an international scale.

Universities and research and scientific units also actively cooperate with the sector of administration, conducting research and analysis for the benefit of public sector units, through e.g., participation in the implementation of joint projects and events. The science sector cooperates with the administration in adapting the fields of education to the requirements of the labor market, it also participates in the preparation and implementation of strategic documents. Educations and colleges also benefit from various instruments of support for their activities, both financial and non-financial, provided by public sector entities.

In addition, as already indicated in the description of the enterprise sector, universities and CTT actively cooperate with entrepreneurs in the field of research and scientific activities, as well as in training staff corresponding to the needs reported by potential employers.

7.1.2.3 Sector of administration

The sector of administration plays an important role in the innovation system. In addition to the Local Government of Region, whose role has already been described earlier, the stakeholders of the system, and thus the entities involved in its implementation, are the Self-government of the Commune, Poviate (as well as managed by them, e.g. poviate labor offices). Activity of local governments related to the support of competitiveness and innovativeness is of indirect nature and beyond creating policy of development it might include in their scope include, e.g.:

- Creation of specialized entities supporting entrepreneurship and creating space for development (e.g. Stalowa Wola Economic Zone, Jasło Business Incubator);
- Granting reliefs and co-financing for investments;
- Organization of trainings;
- Certificates/trainings in EU funds procurement;
- Granting reliefs and co-financing for investments;;
- Co-organizing the conferences for entrepreneurs.

Educational activities and activating the local community are also important, including, i.a. cooperation with local universities, educational units, poviate labor offices and business (in the field of education and development of the local labour market), strengthening the role of the third sector in education and activation of the local community, implementation of projects to counteract digital exclusion and the development of ICT systems and promotion of social innovations.

The administration sector is also formed by state agencies and institutions, including primarily the Polish Agency for Enterprise Development (PARP) as an entity supporting the competitiveness of entrepreneurs, the Industrial Development Agency (ARP) managing the Euro-Park Mielec Special Economic Zone, EURO-PARK WISŁOSAN Tarnobrzeg Special Economic Zone and other units responsible for their proper functioning and creating conditions for the development of enterprises, the National Centre for Research and Development, which is a government executive agency responsible for R&D activities or Polish the Development Fund together with subordinate institutions (primarily the Polish Investment and Trade Agency), offering instruments to e.g., strengthen entrepreneurship. An important link in the administration sector are also the Central Administration Bodies, such as the Statistics Poland and its local unit, i.e. Statistics Rzeszów as entities collecting and sharing a set of data that enables monitoring of the socio-economic development of the region and carrying out analyzes and research for the needs of other entities involved in the implementation of the RIS of the Podkarpackie Province. Activity of the Office within the system involves also active and content-related participation in the process of analysis of the social-economic results obtained by the province. It also conducts statistical education.

Important sources of information in terms of development of entrepreneurship is also Treasury Administration or Central Office of Measures or the Podkarpackie Province Office being the body of the Council of Ministers in the area of the province and the Education Supervisor as the element of the combined administration, responsible for the realization of the educational policy.

Each of the indicated entities, performing its tasks to a greater or lesser extent, cooperates with other elements of the helix. They constitute important sources of knowledge and support both for the sector of enterprises and education. They also support the development of broadly understood society.

7.1.2.4 Society

Society is the element of the quadraple helix which actively participates in the functioning of the innovation system in the Podkarpackie Province. In the course of work on the preparation of the RIS of the Podkarpackie Province, the following stakeholders of the innovation system in the Podkarpackie Region that form this sector were identified: clusters, other non-governmental organizations (NGOs), Chamber of Commerce and Industry, Chambers of Commerce, Podkarpackie Regional Tourism Organization (PROT), Local Action Groups (LAG), schools and cultural centers, and informal groups, local communities and popularizers. All these entities are part of the broadly understood sector of society. The scope of activity of individual stakeholders indicated above is often very different, which is why they have also been assigned separate tasks in the implementation system.

Clusters that associate primarily business representatives and research and scientific units will carry out tasks related to the development of entrepreneurship and increase of the competitiveness and innovativeness of the enterprises in the Podkarpackie Region. They will also be involved in the sector of R&D activity and cooperation between the sector of education and business, as well as in the process of preparation of employees aligned with the needs of the labor market.

Due to the scope of their activities, non-governmental organizations will perform tasks related to, e.g., initiating and strengthening cooperation between science and business or supporting networking cooperation. Due to the fact that these while pursuing statutory objectives, these entities ofter operate in the areas of education, culture or science, they will also be responsible for joining the process of supporting the development of the knowledge-based economy, industrial transformation towards Economy 4.0 or the circular economy, as well as for the popularization of science and innovation. A similar range of tasks will be carried out by schools, cultural centres and other informal groups.

The Chamber of Commerce and Industry and the Chambers of Commerce are entities that to a large extent perform the functions of business environment institutions. Therefore, their tasks will focus mainly in the area of supporting the development of entrepreneurship, including networking and internationalization of Podkarpackie companies or providing various types of basic services (information, consulting, etc.) and specialized services for their needs. They will also act in the support of the research-development activity (providing e.g., IT and analytical services) or in the labor market by means of realization of trainings and course of different type.

PROT's activities in the innovation system will primarily concern support for networking cooperation, especially in the area of Quality of Life specialisation, it will also be involved in the process of knowledge transfer among stakeholders of this specialisation.

Local Action Groups will be responsible for the realization of tasks connected with networking of the cooperation as well as provision of marketing and promotional and analytical services for the purposes of other entities creating the innovation system.

The activities of economic local governments and other business organizations will focus on the implementation of tasks related to strengthening innovation and competitiveness of enterprises, but also on educating staff for the needs of the labor market or increasing the internationalization of enterprises.

Cooperation with other sectors that make up the innovation system is two-way. These entities primarily benefit from the possibility of receiving financial support for their activities and in return undertake activities aimed at the broadly understood socio-economic development of the region, including the promotion of education, dissemination of knowledge, raising qualifications or development of competences in the field of the information society. In addition, they also conduct analyzes required by other entities.

7.1.3 Business environment institutions

Business institutions play a significant role in the functioning of the system of innovation of the Podkarpackie Province and operate between all elements of quadraple helix. Some entities, such as RARR, PIC or PDF, as well as the entities managing special economic zones are a part of the sector of administration. BEIs are also often enterprises providing both basic and specialized services for the needs of other entities, they also include various types of chambers of commerce, which are a representative of the social sector in the system. This is why the scope of their respective tasks was indicated in the description of particular sectors.

The scope of cooperation conducted by BEIs as part of the innovation system of the Podkarpackie Province is very wide. Enterprises are the main recipients of a wide catalog of services provided by BEIs. Universities conduct intensive cooperation, predominantly with BEIs running entrepreneurship and innovation centres. In the case of public administration units, cooperation consists of the usage of instruments provided by the administration by BEIs. Cooperation networks between Business environment institutions and social organizations are not as extensive as between other sectors. BEIs jointly with the non-governmental organizations realize the projects, concerning e.g., development of the social economy[199] (including Third Sector incubators – better times for NGOs implemented by RARR and the Civic Academy Foundation from Przeworsk or the functioning of the Social Innovation Academy at the Podkarpackie Academy of Entrepreneurship).

Business environment institutions, through their services, contribute to the socio-economic development of the region, their representatives also participate in the process of building and developing the innovation system i.a. through participation in the work of the Podkarpackie Innovation Council.

Experience related to the implementation and implementation of Regional Innovation Strategies in the Podkarpackie Province, as well as expert analyses indicate that the current innovation system has been well planned and organized. In its functioning, all elements of the quadruple helix are included, which actively cooperate with each other. The Local Government of Region also fulfils its function as the leader of the system, effectively managing its operation. Therefore, the system does not require significant modifications. During the implementation and implementation of the RIS of the Podkarpackie Province, actions will be taken to strengthen cooperation and increase its effectiveness.

[199] *System innowacji*…, op. cit., pp. 24-64.

7.2 Implementation of strategic objectives by individual elements of the system innovation

The work on the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* allowed to create a matrix of division of activities enabling the implementation and realization of RIS of the Podkarpackie Province. The development of the matrix consisted in identifying all stakeholders of individual elements of the quadruple helix that formed the Podkarpackie innovation system. This was followed by the analysis of the implementation of activities indicated for each of the objectives of the strategy and the tasks performed by individual sectors (this applies to both current tasks and tasks that may potentially be carried out by them in the future). Finally, the collected data were analyzed to identify the entities that will be involved in the implementation of individual activities that allow to achieve operational and horizontal objectives. At the same time, the preparation of the matrix allowed to verify whether there were no gaps in the implementation system RIS of the Podkarpackie Province that would prevent the implementation of any strategic goal. The final shape of the matrix is presented in the table on pages 156-173.

Table 11. Division of implementation tasks within RIS of the Podkarpackie Province taking into account the elements of the quadruple helix

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 1: Development and strengthening of the regional system of innovation	1.1. Increasing the role of innovation in the regional economy	Support for the development of institutions providing pro-innovation services for the enterprise sector	X	X	X	X
		Professionalization of innovation centre services and increasing their potential	X	X		X
		Support for the process of knowledge and technology transfer	X	X	X	X
		Support for the transfer of operating standards between large enterprises and SMEs, exchange of good practices and knowledge, and partnership creation of innovations for the development of smaller companies and Polonization of supplies	X	X	X	X
		Strengthening intellectual property protection activities	X	X	X	X
		Development of R&D activity of scientific units			X	X
		Development of the commercialization system for the results of R&D works in scientific units	X	X	X	X
		Support for the growth of the ability of research sector entities to create and commercialise knowledge, in particular in the areas of regional smart specialisations	X	X	X	X
		Support for the development of R&D activities in areas outside regional smart specialisations	X	X	X	X

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X				X			X		X							
X				X			X		X	X			X			
X				X			X		X	X	X		X	X		
X				X			X		X	X			X	X		
X				X			X		X	X				X		
X				X			X		X							
X				X			X									
X				X					X							
X				X					X							

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 1: Development and strengthening of the regional system of innovation	1.2. Development of cooperation between the most important entities of the regional system of innovation	Support for the creation and development of clusters and cluster initiatives, especially in the areas of smart specialisation and 'aspiring' industries		X	X	
		Support for the creation and development of cooperative links		X		
		Strengthening cooperation between scientific and research institutions and business	X	X	X	X
		Activation of networking cooperation between all entities creating a regional innovation system	X	X		
		Creation of the incentive mechanisms to initiate and conduct cooperation in the enterprise sector and between enterprises and the science sector		X	X	
		SME networking support	X	X		
		Support for activities strengthening institutional (mainly business) links within common value chains		X		
	1.3. Strengthening and development of the regional entrepreneurial discovery process (EDP)	Activation and expansion of the group of participants in the entrepreneurial discovery process		X	X	
		Improvement of instruments for identifying new key industries, economic niches or technologies		X	X	
		Support for the search for technologies combining various industries of economy	X	X	X	

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X			X	X					X		X		X	X		
X				X			X		X	X	X		X	X		
X				X			X		X	X				X		
X	X			X					X	X	X	X	X	X	X	
X				X			X		X							
X				X					X				X	X		X
X				X		X	X		X	X				X		
X				X				X	X	X			X	X		
X				X		X		X					X			
X				X			X		X	X			X	X		

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 2: Growth of innovativeness and competitiveness of the Podkarpackie enterprises	2.1. Strengthening the investment attractiveness of the region	Creation and development of zones of concentration of economic activity		X		
		Stimulation of the creation and development of industrial parks and technological centres, centres of entrepreneurship and innovation, and growth of their potential		X		
		Ensuring the supply of investment areas prepared for conducting business activity		X		
		Support for investment processes and attracting investors	X	X		
	2.2. Creating conditions for the development of entrepreneurship	Support for the creation and development of pre-incubators, business incubators and other forms of assistance in starting a business (e.g. virtual office) and the development of the potential of these institutions	X	X	X	X
		Creation and development of start-up projects	X	X	X	
		Support for the development and scaling of SMEs	X			
		Support for investments in the construction of R&D infrastructure in enterprises		X	X	X
		Support for the development of institutions providing basic services to enterprises	X	X		
		Creation of conditions for the development of interregional cooperation				
		Adaptation of support instruments (including financial support) to the needs and potentials of industries, economic entities (beneficiaries) and geographical areas of operation	X	X	X	
		Strengthening the capacity of public institutions to create conditions for the development of entrepreneurship				

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X			X	X			X									
X				X			X									
X			X				X									
X			X	X	X		X		X	X						
X				X			X			X						
X				X			X									
X				X			X						X	X		
X				X			X									
X				X			X		X	X			X	X		
X				X			X							X		
X	X		X	X			X		X	X	X		X			
X		X		X	X		X	X						X		

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 2: Growth of innovativeness and competitiveness of the Podkarpackie enterprises	2.3. Stimulating the increase of the level of innovation of the enterprises	Strengthening the conduct of R&D activities and its effects in enterprises	X	X	X	X
		Creation and development of incentive mechanisms to increase the level of innovation of enterprises, including in the SME sector		X		
		Support for the development and implementation of new technologies, patents, industrial and utility designs	X	X	X	X
		Creation and development of spin-off and spin-out companies	X	X	X	X
		Activation of the implementation of innovative solutions in 'traditional' branches of the economy	X	X	X	X
		Intensification of the 'green technologies' usage in the enterprises of the region, in particular in the areas of smart specialisation	X	X	X	X
		Support for undertaking cooperation in the field of innovative activities by enterprises	X	X	X	X
	2.4. Strengthening the competitiveness of the enterprises	Boosting action to shorten supply chains	X	X		
		Creation and development of incentive mechanisms to raise the level of competitiveness of enterprises		X		
		Support for the development and implementation of solutions that increase the competitiveness of enterprises	X	X	X	X
		Strengthening the recognition of regional products, brands, especially in the area of smart specialisations		X		
		Provision of basic and specialised services to enterprises	X			X
		Support of business growth by increasing access to financial services and integration into value chains				
		Formation of the resilience of enterprises to the effects of emerging economic crises	X	X	X	

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X				X			X									
X				X			X						X	X		
X				X			X						X	X		
X				X			X		X					X		
X			X	X			X						X	X		
X				X					X	X			X	X		
X				X			X		X	X				X		
X				X			X		X				X	X		
X				X			X		X				X	X		
X			X	X					X		X	X	X	X		X
X				X	X	X	X	X	X	X			X			
X				X			X			X				X		
X				X			X		X	X		X		X		

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 3: Development of the human resources and cultural conditions favorable or raising innovativeness of the region	3.1. Adjusting the system of education to the needs of the labor market	Development of an educational offer corresponding to the needs of industries and professions of the future	X	X	X	
		Support for cooperation between enterprises and the education system in the field of employee training at all levels of education		X	X	
		Development of a system for monitoring and analyzing trends in the field of labour market needs			X	
	3.2. Development of skills, qualifications and competences of the human resources of regional economy and administration	Inspiration to the discovery of professional predispositions, shaping interests and developing the competences of the future (technical and digital, social and higher cognitive competences, including key professional competences31) in formal, informal and non-formal education and lifelong learning		X	X	
		Support for actions aimed at counteracting premature leaving of the labour market by the employees	X	X	X	
		Support for the system of improving professional qualifications and competences by scientific and research staff and teachers, especially teachers of vocational schools		X	X	
		Rinforcement of the employee potential of the university, including the implementation of incentive systems for continuing scientific work for the most talented graduates		X	X	
		Support for the process of improving the qualifications and competences of employees (including scientific personnel) through scholarship programmes		X	X	
		Increase of the scientific potential of enterprises by supporting scientific publications in renowned scientific journals		X	X	X
		Development of pro-entrepreneurial attitudes and raising the level of self-employment	X	X	X	

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X		X			X			X	X				X	X	X	
X		X		X	X		X	X	X				X	X	X	
X		X			X	X										
X		X		X	X				X				X		X	
X		X		X	X								X			
X		X			X				X				X		X	
X													X			
X							X						X			
X	X						X						X			
X		X	X	X	X							X	X		X	X

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
		Stimulation of the development of lifelong learning and raising public awareness of its importance	X	X	X	
		Development of the training offer in the field of lifting/changes in professional qualifications and competences	X	X	X	
Strategic goal 3: Development of the human resources and cultural conditions favorable or raising innovativeness of the region	3.3. Strengthening the culture of cooperation and social innovations	Building social capital in the process of creating and implementing the RIS of the Podkarpackie Province and promoting this process as a good practice of cooperation for innovation in the region		X	X	
		Promotion of the value of knowledge and creativity among children and youth				
		Taking action in the field of 'citizen science'				
		Popularization of science, technology and innovation		X	X	
		Promoting pro-innovation attitudes		X	X	
		Support for the creation and development of local innovation systems and local knowledge systems		X		
Strategic goal 4: Stimulating the development of internationalisation of economy and beneficial participation in global value chains	4.1. Development of internationalization of the enterprises	Reinforcement of the level of export of enterprises from the Podkarpackie Province		X		
		Support for the export of innovative products/technologies		X	X	
		Support and promotion of regional participation of the companies in the international value chains		X		
		Activation of the participation of regional enterprises in the international innovation projects		X	X	
		Support for the development of the level of internationalization of cluster activities		X		

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X		X	X	X	X								X		X	
X		X		X	X								X		X	
X	X	X			X							X	X		X	X
X	X											X	X		X	X
X	X											X	X		X	X
X	X														X	
X	X			X					X			X	X		X	X
X				X					X			X	X			X
X				X			X		X	X			X			
X				X			X		X	X						
X				X			X		X	X						
X				X					X	X			X			

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Strategic goal 4: Stimulating the development of internationalisation of economy and beneficial participation in global value chains	4.2. Economic promotion of the region	Organization of events in the region, economic missions of international scope		X		
		Support for the promotion of regional brands in the arena of international cooperation		X		
		Increase of the presence of the region (Podkarpackie Province) in international initiatives/projects building a framework for cooperation in the areas of R&D and support for entrepreneurship		X	X	
		Intensification of information and promotion activities in the field of innovation undertaken outside and inside the region		X	X	
	4.3. Development of internationalization of regional scientific-research units	Increase of the activity of regional research units in cooperation networks and international thematic platforms			X	
		Promotion and support of th international cooperation of the universities and research organisations			X	
		Creation and development of mechanism encouraging the international cooperation of the regional scientific-research units			X	
Horizontal goal 1: Evolution of regional economy towards Industry 4.0		Support for the development of infrastructure for digital technologies		X	X	
		Creating the conditions to increase the share of digital technology in core business, including customer service	X	X		
		Development of modern methods of communication and diagnostics of industrial objects	X	X	X	
		Improvement of industrial processes related i.a. with design, production, material management and supply chain	X	X	X	

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X								X	X	X						
X									X	X	X					
X				X					X							
X				X					X			X	X			X
X				X			X						X			
X				X			X						X			
X				X			X									
X							X						X			
X								X	X				X			
				X									X			
				X												

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Horizontal goal 1: Evolution of regional economy towards Industry 4.0		Support for the design, creation and development of smart factories and products	X	X	X	X
		Intensification of development and implementation of solutions in the field of automation and robotization of technological and management processes	X	X	X	
		Support for the equipment of scientific and research units in the infrastructure and equipment necessary for active participation in knowledge exchange networks between the main research centres		X	X	
		Support for the development of e-government and cybersecurity		X	X	
		Widespread use of technology, including information and communication technologies	X	X	X	X
Horizontal goal 2: Transformation of enterprises allow for implementing the solutions in circular economy scope, including bio-economy		Support for the transition of production from linear to circular	X	X	X	
		Improving processes for extending the life cycle of products	X	X	X	
		Creating incentive mechanisms for the implementation of effective circular economy solutions in enterprises				
		Support for raising specialist knowledge in the field of circular economy	X	X	X	
		Dissemination of the use of technologies and processes in the field of circular economy	X	X	X	X
		Measures to increase the use of renewable energy sources	X	X	X	X
		Support for the creation and implementation of sustainable models of consumption and production		X	X	

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X				X					X				X			
				X									X			
X				X			X									
X			X	X			X	X								
X			X				X	X					X		X	X
X				X			X		X				X			
X				X			X						X			
X			X	X			X		X							
X			X	X			X		X				X		X	X
X			X	X			X		X				X			
X			X						X			X	X		X	X
X	X			X								X	X		X	X

Basic and horizontal strategic goals	Operational goals	Activities to be implemented	Enterprises sector		Science sector	
			Entities providing basic and specialist services for the enterprises	Other enterprises	Universities and colleges	Centres for Technology Transfer
Horizontal goal 3: Improvement of monitoring instruments for progress of implementation the pro-innovative policy and functioning of innovation ecosystem including identification of bottlenecks for innovation diffusion		Implementation of cyclical reports monitoring the progress of implementation RIS of the Podkarpackie Province 2021-2030				
		Implementation of detailed research on the functioning of the innovation system in the Podkarpackie Province				

Source: own study

Quadruple helix elements (including smart specialisation stakeholders)																
Sector of administration									Society							
Local Government of Region (Podkarpackie Region Board with the help of UMWP Departments)	Podkarpackie Science Center 'Łukasiewicz'	Voivodship Labor Office in Rzeszów	Self-government of the Commune, Poviate	Business environment institutions (including RARR, PCI, PFR, MARR, TARR)	Poviate Labor Offices	Statistics Rzeszów	State agencies and institutions (i.a. PARP, IDA, SEZ, NCBiR, PFR)	Central Administration Bodies (i.a. Statistics Poland, PUW, Education Supervisors, Central Office of Measures, Treasury Administration)	Clusters	Industrial-Commercial Chamber, Economic Chambers	Podkarpackie Regional Tourism Organization	Local Action Groups	Other non-governmental organizations	Economic self-governments and other organisations of the enterprises	Schools and centers of culture	Informal groups, local communities, popularising entities
X		X				X	X									
X		X				X										

7.3 Implementation of the entrepreneurial discovery process within the framework of RIS of the Podkarpackie Province

As indicated in Chapter 3.4, the entrepreneurial discovery process is the basis for identification smart specialisations. It also serves to identify areas of significant importance for the development of the regional economy. This process is also aimed at actively involving stakeholders of the regional innovation system in the implementation of tasks enabling efficient and effective functioning of the entire system.

RIS of the Podkarpackie Province is another innovation strategy being developed in the Podkarpackie Province. The preparation of this document was carried out using EDP. The need to conduct the entrepreneurial discovery process is not limited only to the period of preparation of strategic documents. Its role is even greater during the process of implementation and realization of the Strategy, as it allows for more active participation of representatives of various environments in the innovation system. It also enables establishing and strengthening cooperation between the stakeholders of the system, including the development of joint solutions and projects. The implementation and realization of existing innovation strategies allowed to draw conclusions regarding the EDP conducted in the region and to introduce the necessary modifications and additions under the RIS of the Podkarpackie Province. The EDP will continue to be carried out in already proven forms, i.e. as part of the Smart Specialisation Panels and Metapanels, meetings of the Podkarpackie Innovation Council, as well as during the Podkarpackie Innovation Forums, as well as during other regional, national or international events. Thanks to the involvement of both regional and external experts (from outside the region), all these instruments will provide a space for expanding knowledge, exchanging information and experience, and building networks and partnerships by the stakeholders of the regional innovation system. The initiative for the implementation of individual events will be bottom-up or top-down (i.e. it will be undertaken by the leader of the innovation system, assuming the active involvement of the system's stakeholders in its implementation). In addition to the instruments mentioned above, it is also planned to hold meetings with representatives of industries with the greatest development potential, which (as in the case of Smart Specialisation Panels) will be a space for exchanging knowledge and experience, establishing cooperation and developing joint ventures.

The frequency of implementation of the individual EDP instruments indicated above will depend on the needs of the stakeholders of the regional innovation system. The realization is assumed however of separate panels for particular specialisations including panels for each area of of the Quality of Life specialisation.

The development of the economy of the province is dynamic but also is subject to influence of external factors, such as the economic crisis caused by COVID-19. of the most important assumptions of the entrepreneurship process of discovering will include constant monitoring of the changes taking place due to which it will be possible to implement proper support instruments faster. The current analysis of the development of individual industries will allow to identify areas of the economy that have the potential to become the next smart specialisations of the region. Therefore, the EDP will

continue throughout the duration of the RIS of the Podkarpackie Province. The planned source of financing for the above activities will be the continuation of the project of the Local Government of Region titled *Smart specialisations – a tool for increasing the innovation and competitiveness of the Podkarpackie Province* that is a part of the European Funds for Podkarpackie Province 2021-2030 programme.

8 Monitoring system and financial framework of the RIS of the Podkarpackie Province

8.1 Monitoring system of the RIS of the Podkarpackie Province

Development of the innovation system in the Podkarpackie Province has been a subject to constant monitoring from the moment of implementation and realization of the first innovation strategy for 2005-2013. At that time, a number of studies and analyses were carried out to diagnose the state of the innovation system and the prospects for its strengthening[200]. Also in the following years, many reports and summaries were prepared, deepening the subject of implementation and monitoring of progress in the implementation of the innovation strategy in Podkarpackie Province. The most important studies in this field include:

1. *Leading industries of the Podkarpackie Province – smart regional specialisations* – report created in cooperation with the Regional Territorial Observatory and the Statistics Rzeszów, created on a biannual basis since 2014. The study is devoted to the analysis of indicators in the field of innovation of the region, as well as the development of the industry constituting the Smart specialisations of the region. It should be noted that the development of 2014 also included an analysis of Automotive, which at the time was identified as a high-opportunity sector with the potential to become smart specialisation. At the same time, it was one of the reasons for the subsequent update of the RIS3 Strategy;
2. *Action plans* for individual smart specialisations developed in 2016 by a team of experts led by Prof. Leszek Woźniak, containing, e.g., an indication of the operational objectives assigned to specialisations, as well as the definition of indicators of their implementation;

Topics related to smart specialisations, as well as issues related to the level innovation (including R&D activities) and competitiveness of enterprises from the Podkarpackie Region are analyzed in annual reports entitled *Regional overview. Podkarpackie Province*, created on behalf of the Regional Terri-

[200] Comp. *Regionalna Strategia Innowacji Województwa Podkarpackiego na lata 2005-2013*, Rzeszów 2011, p. 11.

torial Observatory. These studies also include a presentation of the general economic situation of the province compared to other regions of the country.

Important information on the development of the innovation system is also provided by directional research, carried out at the request of the Marshal Office of the Podkarpackie Province. The most important reports developed as a result of the realized research include:

1. *Towns of the Podkarpackie Province – development perspectives*[201] of 2016 and also *the Towns with the functional areas and the poles of growth in the Podkarpackie Province*[202] of 2019 in which smart specialisations were mapped in the context of the development of towns and functional centers of the Podkarpackie Province region. Regional SSs was also juxtaposed with the local specialisations, indicated by the representatives of particular municipal centers as of significant importance for the development of towns;
2. *Entrepreneurship in the Podkarpackie Province – directions of development*[203] – a study carried out in 2017 provided information on the potential of Podkarpackie enterprises and allowed to identify the directions of their development, including in particular companies operating in the areas of smart specialisation;
3. *The potential and activity of the Business environment institutions in the Podkarpackie Province* from 2017, the aim of which was to diagnose the potential and activity of BEIs operating in the Podkarpackie Province region. Within the research the analysis was made in terms of e.g. their role in effective support of innovativeness or the development of the sectors included for the Smart specialisations of the region[204].
4. *Foreign trade and foreign direct investment in Podkarpackie Province*[205] (2014 and 2020 editions) addressing issues related to the e.g. level of development of exports and imports of products, including regional specialisations;
5. *The economy of the Podkarpackie Province in the face of the challenges of Industry 4.0*[206]- analyzing the potential of the regional economy, including industries forming SS to increase competitiveness and innovation through the implementation of solutions of the Fourth Industrial Revolution;
6. *Innovation system in Podkarpackie Province*[207]- a study prepared for the needs of developing RIS of the Podkarpackie Province, comprehensively covering issues related to shaping the innovation system in Podkarpackie Province over the years;
7. *Information and Telecommunications smart specialisation of the Podkarpackie Province*[208], the aim of which was to assess the development of ICT SS compared to other regions of the country and the EU, as well as to identify good practices that help to reinforce the development of specialisation and at the same time are possible to implement in the region.

201 Dziemianowicz W., Charkiewicz J., *Miasta województwa podkarpackiego – perspektywy rozwoju*, Rzeszów 2016.
202 Piróg K., *Miasta wraz z obszarami funkcjonalnymi oraz bieguny wzrostu w województwie podkarpackim*, Rzeszów 2019.
203 *Przedsiębiorczość w województwie podkarpackim*…, op. cit.
204 *Potencjał i działalność Instytucji Otoczenia Biznesu*…, op. cit.
205 *Handel zagraniczny*…, op. cit.
206 *Gospodarka województwa podkarpackiego*…, op. cit.
207 *System innowacji*…, op. cit.
208 *Inteligentna specjalizacja*…, op. cit.

However, the most important study, comprehensively describing the basic guidelines of the Regional Innovation Strategy monitoring, is the *System of the monitoring of RIS3 of the Podkarpackie Province*[209] report, prepared in 2018. The adopted system was aimed not only at monitoring the progress in the implementation of RIS3, but also at providing information for the needs of strategy stakeholders, enabling the formulation of conclusions in the field of development of regional smart specialisations, and thus substantive support of the Podkarpackie Region Board in setting directions for their further development.

The concept presented in the report assumed monitoring of progress from the implementation of the strategy to four levels:

1. Level of EU regions – allowing for the assessment of innovativeness of the Podkarpackie Province in the scope of:
   - Overall innovation, in which the level of development is assessed innovation of Podkarpackie Province compared to other EU regions. The assessment is based on the Regional Innovation Scoreboard report, in which the region's innovation index is determined on the basis of several variables. According to the 2019 edition, the Podkarpackie Province was included in the group of 'moderate –' regions, i.e. characterized by a lower end of the moderate level of innovation;
   - Comparison with 3 regions of EU wit approximate level of innovativeness and with one region with the same or approximate specialisation – for each of the SSs of the Podkarpackie Province (it should be noted that the assumption was that the regions selected for the comparison in terms of specialisation were characterized by a higher level of innovativeness than Podkarpackie Region).

2. National level – the monitoring system assumed showing the development of the province against the background of the country on two levels:
   - In the form of a benchmark with selected regions characterized by a higher level of innovation (Mazovia, Łódź, Małopolska and Wielkopolska Provinces were selected for comparison). The comparison was based on the indicators used in the creation of the Regional Innovation Scoreboard;
   - Comparison of the situation of the province with other regions in terms of part of the indicators for SS monitoring.

3. The level of smart specialisation – assumed an analysis of the development of the SS for the Podkarpackie Province. The indicators specified in the Action Plans for each specialisation were used to carry out the evaluation. For a more comprehensive assessment of their development, the results of surveys conducted in enterprises representing the SS were used.

4. Level of operational goals – assessment of their realization was conducted on the basis of the analysis of performing particular indices, ascribed to the operational goals and on the basis of the surveys with the entrepreneurs[210].

[209] Dziemianowicz W., Cybulska M., *System monitorowania RIS3 województwa podkarpackiego*, Warsaw 2018.
[210] *System monitorowania*…, op. cit., pp. 13-14.

Based on such a monitoring system, monitoring reports were carried out by external contractors. In the years 2019-2020, two reports were prepared in this respect. The implementation of the monitoring system showed some barriers that prevented the fully presented concept from being implemented.

The biggest difficulty is related to the availability of data at the level of smart specialisations. Due to the adopted method of determining the scope of smart specialisations via PCA codes of the conducted activity, the data necessary to monitor the development of specialisation are not published in publicly available sources. Their acquisition is possible only after the appropriate calculations have been made by the Statistics, and thus is a time-consuming process. Additional limitations result from the inability to share part of the data at the regional level due to statistical secrecy (this applies primarily to ICT specialisation), thus making it impossible to monitor the development of specialisation.

Another obvious difficulty was related to the linking of the indices to particular operational goals or assigning specific PCA codes to each specialisation (it refers mainly to the difficulty in separation of the enterprises making up the Aviation and Cosmonautics and Automotive specialisations.

RIS of the Podkarpackie Province monitoring will be based on the following assumptions[211]:

1. Different stakeholders will be involved in the monitoring process as part of the regional innovation system (including e.g. entrepreneurs, representatives of clusters and research units);
2. A broad spectrum of indices will be used coming mainly from the public statistics but also from the survey tests;
3. The development of innovation in the Podkarpackie Province will be subjected to the so-called benchmarking, i.e. compared with selected Polish and EU regions;
4. Due to the weakness of public statistics in the field of smart specialisations monitoring, an important element of monitoring will be the surveys addressed to entrepreneurs and interviews with the stakeholders of the RIS of the Podkarpackie Province.

Objectives of the monitoring of the RIS of the Podkarpackie Province will remain unchanged compared to ones developed in 2018 RIS3 monitoring system. These include:

1. Monitoring the progress of the implementation of the Regional Innovation Strategy of the Province Podkarpackie;
2. Providing information needed for discussion of RIS of the Podkarpackie Province stakeholders in order to formulate conclusions regarding the regional policy for the development of smart specialisation in the Podkarpackie Province, also within the EDP;
3. Substantive support for decisions taken by the Podkarpackie Region Board in the field of development of smart specialisations of the Podkarpackie Province;
4. Increasing knowledge in the region about economic processes based on innovation and improving the quality of activities in the regional innovation system.

[211] Detailed rules on how to monitor the progress of the RIS of the Podkarpackie Province will be defined during the implementation phase Strategies.

RIS of the Podkarpackie Province monitoring will be carried out on four levels:

1. Level of the European Union regions – will serve for the assessment of te innovativeness of the Podkarpackie Province in two sections:

- General innovation – the place of the Podkarpackie Province will be analyzed in the Regional Innovation Scoreboard survey covering 220 EU regions. In the latest edition (2019), the development of individual regions was assessed on the basis of the value of the synthetic innovation index calculated using 18 variables;
- Comparisons with specific EU regions with a similar level of innovation;
- Comparisons of the level of innovation of the Podkarpackie Province with EU regions having the same or similar specialisation

2. National level – will enable the positioning of Podkarpackie Province against the background of other regions of the country. The benchmarking will be based on the indicators used in the Regional Innovation Scoreboard on two levels:

- Reference to the situation in the Podkarpackie Province against the background of the country;
- A detailed comparison of the region's innovativeness to that of four other provinces: Lower Silesia, Łódź, Małopolska and Wielkopolska. These regions identified specialisations of similar or identical nature. However, they are characterized by a higher level of socio-economic development and a similar or higher level of innovation;

3. The level of smart specialisations – this form of monitoring shall concentrate on four distinguished specialisations. Both metaindication of specialisation as well as the results of the survey will be used to assess their development.

- The meta indicator for a given smart specialisation will be the quotient value:

  X = [Eip/Ejp] / [Eipl/Ejpl]

  where:
  Eip- the number of companies of a given specialisation in Podkarpackie Province,
  Ejp- the number of all companies in Podkarpackie Province,
  Eipl- number of companies of a given specialisation in Poland,
  Ejpl- number of all companies in Poland
  X=
  For the calculation of the metaindicator value, the number of companies was taken into account due to the lack of availability of other data illustrating the development of entrepreneurship at regional level. In order to properly estimate the number of companies belonging to a given specialisation, expert assignment of appropriate PCA was made at the level of sections, departments, groups and classes for each SS.

- Due to weaknesses in statistical data, SS monitoring requires application of field research in the form of surveys and both individual and group interviews. This allows to gather data of both quantitative (surveys) and qualitative (interviews) character that will also be an important element of the regional EDP. The use of several research tools will allow to draw the right conclusions in the assessment of individual specialisations.

The research topics will concern:

- the overall situation in the SS area, including barriers to development of innovation,
- implementation of the regional operational programme in the field of specialisation,
- directions SS development in terms of improving existing and conditions for the creation of new value chains,
- directions of development of specialisation in scope of improving cooperation with other SSs,
- directions of SS development in scope of using the operational objectives of RIS of the Podkarpackie Province
- barriers to the development of RIS of the Podkarpackie Province.

4. Level of operational objectives – each of the operational objectives of the RIS of the Podkarpackie Province is assigned to indicators to assess their implementation. Due to the limitations of official statistics, some of the objectives were assigned indicators obtained from other sources, such as data obtained from surveys carried out on a full sample of the universities in the Podkarpackie Region or data obtained from the UMWP. These indicators are listed in the table below.

Table 12. Ratios of monitoring operational goals of RIS of the Podkarpackie Province[212]

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
1.1. Increasing the role of innovation in the regional economy	Business environment institutions for 10,000 entities of the national economy	Statistics Poland Local Data Bank	Increase
	Number of publications of scientific staff of Podkarpackie universities published in scientific journals and publishing houses	Survey addressed to all universities anc colleges in the Podkarpackie Province	Increase
	Total applications for inventions in the Polish Patent Office	Statistics Poland Local Data Bank	Increase
	Total patents granted by the Polish Patent Office	Statistics Poland Local Data Bank	Increase
	Share of patents granted to scientific units of the Polish Academy of Sciences, research institutes, universities and colleges in the total number of applications	Statistics Poland Local Data Bank	Maintaining the current level or increase
	Total applications for utility models in the Polish Patent Office	Statistics Poland Local Data Bank	Increase
	Protection rights granted on utility models in the Polish Patent Office	Statistics Poland Local Data Bank	Increase

212 Indicators, their sources and expected results may change during the development phase of detailed rules monitoring

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
	Number of research laboratories in he universities and colleges in the Podkarpackie Province	Survey addressed to all universities anc colleges in the Podkarpackie Province/ POLon / PCI	Increase
	R&D expenditure in the public sector as a percentage of GDP	*Regional Innovation Scoreboard*[213]	Maintaining the current level or increase
	Number of implementations of the results of scientific research or development works by other entities carried out by the universities and colleges in the Podkarpackie provinces	POLon database/ survey addressed to all universities anc colleges in the Podkarpackie Province	Increase
1.2. Development of cooperation between the most important entities of the regional system of innovation	Industrial enterprises cooperating in a cluster initiative or other formalised cooperation as % of active enterprises in innovation aspects	Statistics Poland Local Data Bank	Increase
	Number of active clusters[214]	Data obtained from cluster coordinators	Maintaining the current level or increase
	Number of cluster members[215]	Data obtained from cluster coordinators	Increase
	Enterprises that have cooperated in innovation activities in % of total enterprises	Statistics Poland Local Data Bank	Increase
	Innovative SMEs collaborating with others as % of SMEs	*Regional Innovation Scoreboard*	Increase
	Publications in public-private cooperation per million inhabitants	*Regional Innovation Scoreboard*	Maintaining the current level or increase
	Number of orders realized for the enterprises by the universities and colleges from the Podkarpackie Province	Universities and colleges	Increase

213 *Regional Innovation Scoreboards* are available in cycles every two years.

214 Concerns clusters that provide cyclical information to the UMWP for the purpose of monitoring the implementation of the Regional Development Strategy.

215 Concerns clusters that provide cyclical information to the UMWP for the purpose of monitoring the implementation of the Regional Development Strategy.

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
1.3. Strengthening and development of the regional entrepreneurial discovery process (EDP)	Number of Completed Smart Specialisation Panels and Metapanels	UMWP Department of Regional Development	Increase
	Number of organized meetings with stakeholders of high-opportunity industries	UMWP Department of Regional Development	Increase
	Number of organized PIC sessions	UMWP Department of Regional Development	Increase
2.1. Strengthening the investment attractiveness of the region	Capital expenditures for 1 Staff Member	Statistics Poland Local Data Bank	Increase
	Capital Expenditure by PAC 2007 section	Statistics Poland Local Data Bank	Maintaining the current level or increase
	Entities with foreign capital per 10,000 inhabitants	Statistics Poland Local Data Bank	Increase
	Companies with foreign capital in Poland in accordance with the data of Statistics Poland	Statistics Poland Local Data Bank	Increase
	Capital expenditures in entities with foreign capital	Statistics Poland Local Data Bank	Increase
	Net financial result of entities with foreign capital	Statistics Poland Local Data Bank	Increase
2.2. Creating conditions for the development of entrepreneurship	Newly registered entities of the national economy in the REGON register in total	Statistics Poland Local Data Bank	Increase
	Entities newly registered according to PAC 2007 section groups	Statistics Poland Local Data Bank	Increase
	Value of support provided under repayable financial support instruments	Podkarpackie Development Fund	Increase
2.3. Stimulating the increase of the level of innovation of the enterprises	Enterprises assigning expenditures on innovative activities	Statistics Poland Local Data Bank	Increase
	Percentage share of family enterprises in the total number of enterprises in selected countries.	Statistics Poland Local Data Bank	Increase
	Innovative enterprises by type of innovation introduced	Statistics Poland Local Data Bank	Increase
	Expenditures on innovative activities in enterprises in relation to GDP	Statistics Poland Local Data Bank	Increase

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
	Internal expenditures on R&D activities in relation to GDP	Statistics Poland Local Data Bank	Increase
	Share in the production sold of the new/improved products in the industrial enterprises as the value of sales of products in total	Statistics Poland Local Data Bank	Increase
	Expenditures on innovative activities in enterprises per type of the innovative activity	Statistics Poland Local Data Bank	Increase
	Share of net revenues from the sale of products of entities classified as high and medium-high technology	Statistics Poland Local Data Bank	Increase
	Internal R&D personnel in the enterprise sector	Statistics Poland Local Data Bank	Increase
2.4. Strengthening the competitiveness of the enterprises	GDP per capita [PLN]	Statistics Poland Local Data Bank	Increase
	Gross value of fixed assets in enterprises per 1 inhabitant (PLN)	Statistics Poland Local Data Bank	Increase
	Dynamics of sold production of industry in PCA section C, divisions 25-30	Statistics Poland Local Data Bank	Increase
	Number of entities of the national economy entered in the REGON register	Statistics Poland Local Data Bank	Increase
	Investment outlays in enterprises per 1 inhabitant (PLN)	Statistics Poland Local Data Bank	Increase
	Sources of financing capital expenditures in enterprises in total and divided into individual sources	Statistics Poland Local Data Bank	Increase
	Total revenues from the total activity of enterprises	Statistics Poland Local Data Bank	Increase
	Gross returns on sales	Statistics Poland Local Data Bank	Increase
	Share of the number of enterprises showing net profit in revenues from total operations	Statistics Poland Local Data Bank	Increase

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
3.1. Adjusting the system of education to the needs of the labor market	Percentage of students studying in technical and natural sciences (students and graduates)	Statistics Poland Local Data Bank	Increase
	Number of graduates in the field of ICT	Statistics Poland Local Data Bank	Increase
	Enrolment rate (net)%: a) basic vocational schools and stage I sectoral vocational schools (b)vocational schools (excluding basic vocational, stage I sectoral vocational schools and special schools preparing for work) and general professional schools	Statistics Poland Local Data Bank	Increase
	Students in secondary schools (excluding special schools) by subgroups of courses of education ISCED-F – 2013	Statistics Poland Local Data Bank	Increase
	Number of classes on a page	Superintendent	Maintaining the current level or increase
	Total university graduates	Statistics Poland Local Data Bank	Increase
	Academic teachers by academic degree in related disciplines with smart specialisations of the region	Survey addressed to all Podkarpackie universities	Increase
3.2. Development of skills, qualifications and competences of the human resources of regional economy and administration	Adults in education or training aged 25-64	Statistics Poland Local Data Bank	Increase
	Number of entities that received funding for the implementation of training services	Voivodship Labor Office in Rzeszów	Increase
	Number of inhabitants of the province who used courses and trainings by means of the Development Services Base	PARP	Increase
	Postgraduate students per 10,000 population	Statistics Poland Local Data Bank	Increase
	Active doctoral students	Statistics Poland Local Data Bank	Increase
	Foundations, associations and social organizations per 1,000 inhabitants	Statistics Poland Local Data Bank	Increase
	Active organizations and associations: associating natural persons, associating legal persons	Statistics Poland Local Data Bank	Increase

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
	Organisations by legal and rganizational form: in total and by legal form	Statistics Poland Local Data Bank	Increase
	Organizations by main field of activity	Statistics Poland Local Data Bank	Increase
	Number of student teams implementing protoLab projects	PIC	Increase
4.1. Development of internationalization of the enterprises	Value of exports by industry	Analytical Center of Customs Administration	Increase
	Sources of deposits broken down into sectors	Analytical Center of Customs Administration	Increase
	Number of companies from the Podkarpackie Province participating in the Horizon Europe programme	Horizon Europe database	Increase
	Number of offer records investment in the PAIH database	PAIH	Maintaining the current level or increase
4.2. Economic promotion of the region	Number of organized economic events of international scope	UMWP Department of Promotion, Tourism and Economic Cooperation	Increase
	Participation of the entities from the Podkarpackie Province in missions and economic fairs organized by PAIH	PAIH	Increase
4.3. Development of internationalization of regional scientific-research units	Number of Horizon Europe projects in which universities and colleges from the Podkarpackie Province have participated	Horizon Europe database	Increase
	Number of articles and studies published in the Scopus database	Survey addressed to all universities and colleges from the Podkarpackie Province	Increase
	Number of international cooperation networks in which Podkarpackie universities participate	Survey addressed to all universities and colleges from the Podkarpackie Province	Increase

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
Horizontal goal 1: Evolution of regional economy towards Industry 4.0	Leveraging Industry 4.0 solutions in enterprises smart specialisation	Smart specialisation reference	Increase
	Companies with broadband Internet access	Statistics Poland Local Data Bank	Increase
	Companies receiving orders via Internet networks	Statistics Poland Local Data Bank	Increase
	Companies with a website	Statistics Poland Local Data Bank	Increase
	Companies using the Internet in their contacts with public administrations to send completed forms in electronic form	Statistics Poland Local Data Bank	Increase
Horizontal goal 2: Transformation of enterprises allow for implementing the solutions in circular economy scope, including bio-economy	Share of industrial waste water treated in waste water requiring treatment	Statistics Poland Local Data Bank	Increase
	Industrial waste water treated per 100 km^2	Statistics Poland Local Data Bank	Increase
	Reused industrial wastewater	Statistics Poland Local Data Bank	Increase
	Recycled installations (excluding energy recycling and pits flling)[216]	Statistics Poland Local Data Bank	Increase
	Energy recovery plantsi[217]	Statistics Poland Local Data Bank	Increase
	Number of plants particularly burdensome for air purity	Statistics Poland Local Data Bank	Decrease
	Air pollutants retained in abatement equipment in plants particularly nuisance in % pollution produced	Statistics Poland Local Data Bank	Increase
	Pollution prevention – new techniques and technologies for fuel combustion, including modernisation of boiler and heating plants	Statistics Poland Local Data Bank	Increase
	Facilities generating waste	Statistics Poland Local Data Bank	Maintenance of the current level
	Waste generated within recovered year	Statistics Poland Local Data Bank	Increase

216 Data made available by the Statistics Poland every two years.
217 Data made available by the Statistics Poland every two years.

Operational goals	Indicators for monitoring the achievement of the goal	Data source	Target trend
	Energy saving per 1 inhabitant	Statistics Poland Local Data Bank	Increase
Horizontal goal 3: Improvement of monitoring instruments for progress of implementation the pro-innovative policy and functioning of innovation ecosystem including identification of bottlenecks for innovation diffusion	Number of Reports executed from monitoring the implementation of RIS of the Podkarpackie Province	UMWP Department of Regional Development	Increase
	Number of studies carried out on pro-innovation policies	UMWP Department of Regional Development	Increase
	Number of visitors to the site RSI. Podkarpackie.pl	UMWP Department of Regional Development	Increase
	Number of completed Podkarpackie Innovation Forums	UMWP Department of Regional Development	Increase
	Number of members of the Regional Innovation and Start-up Ecosystem	PIC	Increase

Source: own study

The monitoring report will cover the following issues:

1. Innovation of the Podkarpackie Province against the background of EU regions;
2. Innovation of the Podkarpackie Province against the background of selected benchmark regions;
3. Innovation of the Podkarpackie Province against the background of selected Polish provinces;
4. Identification of smart specialisations of the Podkarpackie Province is a process data from surveys and individual interviews;
5. Implementation of the operational objectives of the RIS of the Podkarpackie Province;
6. Conclusions and recommendations for discussion at e.g., forum of the Podkarpackie Innovation Council.

RIS of the Podkarpackie Province monitoring reports will be prepared in annual cycles (with a provision that due to the frequency of data sharing by e.g., official statistics agencies, the value of certain indicators will be updated only as they become available). In addition, an ex post evaluation of the implementation of the Strategy will be carried out. The entity responsible for their implementation of tasks related to monitoring and evaluation of RIS of the Podkarpackie Province will be provided by the Department of Regional Development.

8.2 Financial framework of the RIS of the Podkarpackie Province

Adoption of the five objectives of cohesion policy for the period 2021-2027 by the European Union explicitly shows that the focus on innovation of economies, countries and regions already observed in previous budgetary perspectives will continue. It should be emphasized that the first two objectives: 'a smarter Europe' and 'a greener, carbon-free Europe' will together account for at least 65% of the ERDF and ESF funds, with a particular focus on creating and exploiting innovation.

RIS of the Podkarpackie Province, as has already been repeatedly emphasized, is a development programme covering not only the development of innovation and competitiveness of the region, but also the area related to with employee training. With such a comprehensive approach, it is impossible to finance all activities to be implemented from the very limited funds of the province budget. Therefore, the main source of funding for the Strategy will be EU funds from various programmes, both national and European.

The draft Partnership Agreement of July 2021 provides for the total allocation of EU funds for Poland equal to EUR 76,532,556,481 (EUR 71,609,299,126 under cohesion policy), out of which EUR 53,353,897,797, i.e. 82.35 % of the total amount will be allocated to less developed regions[218]. For the implementation of Policy Objective 1, the projected allocation (at national level) will reach EUR 11,371,294,082, including EUR 9,583,316,224 for less developed areas[219]. The document also assumes the concentration of support in the areas that will most fully enable the implementation of the objectives set in the Partnership Agreement while guaranteeing the financing of projects that bring the greatest effects[220].

Precise definition of all possible sources of financing, as well as the allocation that can be allocated to activities included in the RIS of the Podkarpackie Province is currently impossible. At the time of preparing the draft Strategy, the work on the final shape of the Partnership Agreement is still underway and the strategy for the intervention of European funds in accordance with the cohesion policy and the common fisheries policy in Poland in the years 2021-2027 is still being decided. Therefore, the potential and most likely sources of funding for the RIS of the Podkarpackie Province are indicated below, together with the overall allocation at regional or national level.

8.2.1 Implementation instruments

Implementation of the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* will be conducted using various types of financial and non-financial instruments. Undoubtedly, the most important of them is the Regional Operational Programme of the Podkarpackie Province (covering both the programming period 2014-2020 and the new programme – European Funds for Podkarpackie Province for the years 2021-2027). It will be the main source of financing projects that

218 *Projekt Umowy Partnerstwa dla realizacji Polityki Spójności 2021-2027 w Polsce*, Warsaw 2021, p. 148.
219 Ibidem, p. 169.
220 Ibidem, p. 177.

fall within the scope of smart specialisations of the region, both in the area related to the development of innovation and competitiveness of the Podkarpackie economy, as well as activities related to the education of personnel responding to the needs of the labor market. The programme finances the implementation of the Local Government of Region own projects aimed at the Region's economic development, e.g., *Smart specialisations – a tool for increasing the innovation and competitiveness of the Podkarpackie Province*, Economic Promotion of the Podkarpackie Province or Podkarpacka Business Support Platforms, described in earlier chapters.

Another important implementation instrument is the Operational Program – Eastern Poland 2014-2020 and its successor designed for the 2021-2027 period. Financial resources coming from the programme are used for e.g., the development of the entrepreneurship, especially in innovations. The following programmes will also be important instruments:

- European Funds for Modern Economy 2021-2027;
- European Funds for Infrastructure Climate, Environment 2021-2027;
- European Funds for Digital Development 2021-2027.

These instruments are described in more detail in the following subsections.

For the effective implementation and implementation of RIS of the Podkarpackie Province, it will be important not only to support the development of regional SS, but also to take action to strengthen the so-called high opportunity industries. An important role in this process will be played by elements of the EDP conducted in the region, i.e. primarily Panels and Metapanels of Smart Specialisations, meetings of the Podkarpackie Innovation Council, Podkarpackie Innovation Forums and meetings with stakeholders of industries not included in the scope of SSs. Other instruments (including financial ones) will also be important, enabling i.a. support for economic sectors that have the potential to become the next smart specialisations of the region.

Realization of RIS of the Podkarpackie Province will also use financial instruments offered by the Podkarpacki Development Fund from the funds returned within the Regional Operational Program of the Podkarpackie Province for the years 2007-2013. These funds are allocated for the support of the development of SME sector including all companies which have difficult access to other sources of financing.

8.2.2 European Funds for Podkarpackie Province 2021-2027

The Regional Programme European Funds for Podkarpackie Province 2021-2027 (FEP) is the successor of the Regional Operational Programme for 2014-2020. The programme will be financed by the European Regional Development Fund (ERDF) and the European Social Fund + (ESF+).

The amount of funds allocated for the implementation of the programme, as well as its scope, are the subject of negotiations on the programme contract of the province board with the minister competent for regional development. The programme contract indicates i.a. for the maximum amount of subsidy for the programme with the funds coming from the EU Funds or the state budget and minimum amount of the domestic contribution necessary for its realization which will be assured by the Local Government of Region from own funds or the funds of the beneficiaries of the programme.

In terms of the scale and terms of financing, the draft programme contract is agreed with the minister responsible for public finances.

The scope of intervention results from the Regional Development Strategy and is developed as part of the working groups appointed by the Podkarpackie Region Board, representing various sectors and stakeholders. The goal of individual negotiations of the contract is to adjust as best as possible the intervention of the programmes to the diagnosed needs and potentials of the regions. The subject of the intervention of regional programs are investments in e.g., the conduct and implementation of research and development activities of enterprises, support for SMEs, e-public services at regional and local level, clusters, RES development, energy efficiency, adaptation to climate change, protection of areas valuable due to nature, water retention, water and sewage management, waste management, infrastructure in the field of culture and tourism, professional activation, raising qualifications, services environmental: social, long-term and psychiatric care, e-services, social integration, support for social economy entities, education for the needs of the labour market, prevention in protection health, standards of service in medical institutions.

The programme (including primarily the allocation dedicated to Priority 1, but also part of the funds from Priority 4) will be the main source of financing activities related to the implementation of the Development of the WP RSI concept.

Table 13. Allocation within the European Funds for the Podkarpackie Province 2021-2027 programme

Programme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for Podkarpackie Province 2021-2027	FEP	1634,5	288,4	1922,9
	ESF+	546,8	96,5	643,3

Source: own study

8.2.3 European Funds for the Modern Economy

European Funds for the Modern Economy 2021-2027 (EFME) programme constitutes the continuation of two programmes: Innovative Economy 2007-2013 and Smart Development 2014- 2020. The Program assumes the realization of the three priorities concerning support for the entrepreneurs, environment friendly for the innovations, as well as technical aid. Realization of EFME will be directed to achieving the goals concerning growth of potential in R&D, growth of competitiveness of SME, development of the abilities related to smart specialisations, industrial transformation and entrepreneurship, and a transformation of the economy itself

As part of the first priority of the programme, activities related to the implementation of new solutions, the creation and expansion of R&D infrastructure, the development of internationalization, competences, automation and robotization or solutions in the field of green economy will be supported. Activities belonging to the second priority will focus on projects of strategic importance for the national economy. They will include tasks related to e.g., the development of research infrastructure in public institutions, transfer and commercialization of technologies developed

at universities and institutes, strengthening the potential of BEIs or supporting start-ups. The total allocation for the programme will be about EUR 7.9 billion, of which 98% is to be allocated to actions belonging to the first two priorities. Support in scope of the programme will be provided in the form of grants, financial, equity and guarantee instruments and instruments combining repayable and grant financing[221].

Table 14. Domestic allocation within the European Funds for the Modern Economy 2021-2027 programme

Progratmme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for the Modern Economy 2021-2027	EFME	7973	2029	10 003
Allocation method for less developed regions		6566	1159	7725

Source: own study

8.2.4 European Funds for Eastern Poland

The European Funds for Eastern Poland 2021-2027 programme (EFEP) is a continuation of support programmes for this macro-region, i.e. of the Eastern Polish Operational Programme for the years 2007-2013 and 2014-2020. For its beneficiaries (i.e., Lubelskie, Podlasie, Podkarpackie, Świętokrzyskie and Warmińsko-Mazurskie Provinces) it was an important source of financing for many investments, allowing at the same time for reducing the developmental gaps in relation to other provinces of the country. In the current perspective, Masovian Province (excluding Warsaw and the surrounding districts) will join the the five existing beneficiaries.

EFEP will focus on areas related to the increase of innovation and competitiveness of enterprises, activities related to climate protection enabling the improvement of the quality of life of residents, increasing the transport accessibility of the entire macro-region, activation of social capital or the development of tourism using the potential of health resorts. The Program will be directed, among others, to the sector of micro-, small and medium enterprises conducting or intending to conduct activity in the area of macro-region centers of innovation, energetic enterprises, units of territorial local government on status of health resort, area of resort protection, entities providing sanatorium and resort services, institutes of resort treatment or the non-governmental organizations and their partnerships. The programme provides support for activities carried out in areas related to e.g., entrepreneurial development (such as the creation of start-ups), electricity infrastructure, adaptation to climate change or sustainable urban mobility, health resorts and tourist products[222].

221 https://www.poir.gov.pl/strony/o-programie/fe-dla-nowoczesnej-gospodarki/zalozenia-programu-feng/ [access 07.06.2021].

222 https://www.polskawschodnia.gov.pl/strony/o-programie/fe-dla-polski-wschodniej-2021-2027/zalozenia-nowego-programu/ [access 08.06.2021].

Table 15. Domestic allocation within the European Funds for Eastern Poland 2021- 2027 programm

Programme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for the Easter Poland 2021-2027	EFEP	2508	443	2951

Source: own study

8.2.5 European Funds for Infrastructure, Climate, Environment

European Funds for the Infrastructure, Climate, Environment 2021-2027 (FEnIKS) is the successor of the programmes, within which the financial support was disposed for the purposes connected with infrastructure and environment in two previous financial perspectives. FEnIKS will focus on improving the conditions for sustainable development of the country through the construction of technical infrastructure and social. This will be achieved by investments directed to the areas falling within the scope of the RIS of Podkarpackie Province, related to e.g., decarbonisation of the economy and its transformation towards a circular economy (including increasing the share of energy from renewable sources), ensuring equal access to high-quality health services and improving the resilience of the health care system. The offer of the programme can be used, among others, by entrepreneurs, units of territorial local government, suppliers of energetic services, non-governmental organization or health care institutions. Support under FenIKS will be available in the form of grants, financial instruments and instruments combining both forms[223].

Table 16. Domestic allocation within the European Funds for Infastructure, Climate, Environment 2021-2027 programme

Programme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for Infrastructure, Climate, Environment 2021-2017	ERDF	12 820	3264	16 084
	CF	12 266	2165	14 430
Allocation for less developed regions	ERDF	10 558	1863	12 421

Source: own study

8.2.6 European Funds for Digital Development

The European Funds for Digital Development 2021-2027 (EFDD) programme replaced the Digital Poland programme, which in the previous perspective was the main source of financing for digital transformation in Poland. Realization of the pogram will facilitate the implementation of the digital technological progress connected with the revolution of Industry 4.0.

[223] https://www.pois.gov.pl/strony/o-programie/fundusze-europejskie-na-infrastrukture-klimat-srodowisko/zalozenia-programu/ [access 08.06.2021].

EFDD support will focus on activities related to: building a gigabyte society in the country, developing e-services corresponding to the 4th and 5th degree of maturity for citizens and entrepreneurs, strengthening cybersecurity, developing a data-driven economy using the latest digital technologies, strengthening cooperation in creating digital solutions to socio-economic problems or an area related to the development of advanced digital competences.

The support under the programme will be available to entrepreneurs, public administration, non-governmental organisations, entities of tertiary education, science and medicine, as well as to the cultural institutions. It will be awarded in the form of grants[224].

Table 17. Domestic allocation within the European Funds for Digital Development 2021-2027 programm

Programme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for Digital Development 2021-2027	EFDD	1988	506	2494
Allocation for less developed regions		1637	289	1926

Source: own study

8.2.7 European Funds for Social Development

The European Funds for the Social Development 2021-2027 programme (EFSD) constitutes the continuation of the Knowledge Education Development programme (POWER) realized in the financial perspective of 2014-2020. EFSD will be a source of funding for e.g., activities that fall within the scope of the RIS of the Podkarpackie Region concerning improvement of the situation of people on the labour market, increase of the quality of education and improvement of the competences and social inclusion, and the development of social services and the social economy, including health care.

The implementation and realization of the programme will focus on achieving objectives in the areas of e.g., strengthening the health and education system, training staff for the economy, increasing the use of social innovations (including in the provision of public services) or developing social and civil dialogue.

The main beneficiaries of EFSDP, next to the governmental administration shall include non-governmental organizations, entrepreneurs, social partners, schools, scientific units, and facilities and institutes of health care. Support will be provided in the form of both grants and financial instruments[225].

224 https://www.polskacyfrowa.gov.pl/strony/o-programie/fundusze-europejskie-na-rozwoj-cyfrowy-2021-2027/zalozenia-do-nowego-programu/ [access 08.06.2021].

225 https://www.power.gov.pl/strony/o-programie/fundusze-europejskie-dla-rozwoju-spolecznego/zalozenia-nowego-programu/ [access 08.06.2021].

Table 18. Domestic allocation within the European Funds for Social Development 2021-2027 programme

Programme	The Fund	EU contribution [EUR million]	National contribution [EUR million]	Total [EUR million]
European Funds for Social Development 2021-2027	ESF+	4049	1031	5080
Allocation for less developed regions		3335	588	3923

Source: own study

8.2.8 National Recovery Plan

The National Programme for Reconstruction and Resilience (NPRR) is a new tool aimed at reconstruction the Polish economy after the collapse caused by the COVID-19 pandemic, as well as increasing its resilience to potential future crises. The implementation of the programme was planned for the period ending in August 2026.

The programme will focus on the areas identified as pillars of crisis response and building economic resilience. These include green and digital transformation, smart and sustainable growth that enhances social inclusion, social and territorial cohesion, healthcare, economic, social and institutional resilience, and the design and implementation of policies for the next generation, e.g. related to education and skills.

The funds for the NPRR provided by the EU Recovery and Resilience Facility might amount to EUR 58.1 billion. The first stage of the programme includes non-repayable forms of support to the amount of EUR 23.9 billion. In addition, when submitting the NPRR to the European Commission, Poland was to apply for the allocation of over EUR 12.1 billion from the loan part of the RFF for activities related to the digital and climate transformation, as well as for the implementation of the accompanying necessary reforms[226].

8.2.9 Financial return instruments from the funds of ROP of the Podkarpackie Province in 2007-2013 and 2014-2020

An additional source of financing for the RIS of the Podkarpackie Province will be financial instruments from repayable funds withdrawn from the regional operational programmes of the Podkarpackie Province under previous programming periods that are at the disposal of the Local Government of Region. The implementing entity will be e.g., Podkarpackie Development Fund, which is a company of the Local Government of Region. These measures are intended to serve the development of the small and medium-sized sector enterprises in Podkarpackie Province. Support will be provided in the form of e.g., (liquidity) loans, working capital loan and mortgage, prolon-

[226] *Projekt Krajowego Programmeu Odbudowy i Zwiększania Odporności*, Warsaw 2021, pp. 3-4.

gation, sureties, guarantees and promises). Entrustment agreement to PFR Sp. z o.o. of the funds withdrawn from ROP of the Podkarpackie Province 2007-2013 amounted to 120 mln PLN.

Within the Agreement concluded between the Podkarpackie Province and the Bank Gospodarstwa Krajowego from the funds allocated for ROP of the Podkarpackie Province 2014-2020 (Axis I) coming from the European Fund of Regional Development for the returnable financial instruments, the amount of PLN 435 mln was allocated (total value of the project is PLN 475,196,921.79). The project is to be completed on December 31, 2023. Currently, the first turnover of funds under the project is underway, with the indication that its beneficiary (i.e. BGK) also received permission to reuse part of the returned resources.

Additionally, from the ESF funds within the operation 7.3 of the ROP of the Podkarpackie Province 2014-2020 in the non-competition project realized by Bank Gospodarstwa Krajowego allocation for the returnable instruments for the operations related to the support of entrepreneurship amounted to almost PLN 25 mln (EU contribution). Total amount of the project constituted slightly above PLN 29 mln.

8.2.10 Framework Programmes of the European Union

In addition to the funds indicated in the previous sub-chapters, the actions to be implemented under the RIS of the Podkarpackie Province, might be eligible for the support from the European programmes, which include:

- Horizon Europe for the years 2021-2027, which is an important source of funding for research, developing international cooperation and increasing the innovativeness of enterprises. Its aim in the next perspective will be to introduce systemic changes that are necessary for building a green, healthy and resilient Europe. The budget of this programme is EUR 95.9 billion, of which 35% will be allocated to climate objectives[227].
- Clean Sky 2 is part of Horizon Europe 2020's research and innovation programme. Clean Sky 2 is the largest European support programme for the R&D&I, concentrating on the objectives related to the reduction of carbon dioxide and lowering emission of gases and noise emitted by the aviation by 20-30% (in comparison with 2014). It covers a ten-year programming period (2014-2024). With a budget of EUR 1.8 billion, it supports cooperation and competitiveness in the European aviation industry by providing innovative solutions for the sector[228].
- React-EU (Recovery Assistance for Cohesion and the Territories of Europe) programme with a budget of EUR 50.6 billion (including EUR 60 million for three Polish provinces: Kujawy-Pomerania, Pomerania, Podlasie and Podkarpackie). The programme will focus on clean transport, improving the resilience of the healthcare system, purchasing equipment enabling SMEs to work remotely, increasing the availability of e-services in the health sector and photovoltaics[229].

227 https://www.horizon-eu.eu/ [access 08.06.2021].

228 https://www.cleansky.eu/technology-evaluator [access 08.06.2021].

229 https://ec.europa.eu/regional_policy/pl/newsroom/news/2021/11/25-11-2021-react-eu-more-than-eur60-million-to-support-health-smes-and-energy-efficiency-in-three-polish-regions [access 29.12.2021].

8.2.11 Other potential sources of funding

An important source of financing activities aimed at increasing innovation and the competitiveness of companies are also own expenditures incurred by enterprises in this area. A potential source of funds for such activities may also be the funds of private investors. Additional sources of financing may also be own funds of local government units, including the Local Government of Region, as well as funds from the budgets of state legal persons (e.g. special purpose funds), NCBiR funds, or the Polish Development Fund. However, it should be borne in mind that the value of possible expenditures from private resources allocated for the implementation of tasks in the above scope is extremely difficult to estimate.

8.2.12 Linking operational objectives to potential sources of funding

In order to optimally match the available sources of support to the activities to be implemented in the RIS of the Podkarpackie Province, and at the same time to identify areas that will require the design of separate instruments, in the course of work on the innovation strategy, an attempt was made to allocate potential sources of financing to individual operational objectives. This allocation is presented in the table below.

Table 19. Matrix of affiliation of operational goals of the RIS of the Podkarpackie Province with potential sources of financing

Operational goals	Sources of financing									
	European Funds for Podkarpackie Province	EFME	EFEP	FEnIKS	EFDD	EFSD	KPO	Regional repayable instruments	Framework programmes	Other potential sources of funding
1.1. Increasing the role of innovation in the regional economy	X	X					X		X	X
1.2. Development of cooperation between the most important entities of the regional system of innovation	X	X					X		X	X
1.3. Strengthening and development of the regional entrepreneurial discovery process (EDP)	X									X
2.1. Strengthening the investment attractiveness of the region							X			X
2.2. Creating conditions for the development of entrepreneurship			X							X
2.3. Stimulating the increase of the level of innovation of the enterprises	X	X	X					X	X	X

Operational goals	Sources of financing									
	European Funds for Podkarpackie Province	EFME	EFEP	FEnIKS	EFDD	EFSD	KPO	Regional repayable instruments	Framework programmes	Other potential sources of funding
2.4. Strengthening the competitiveness of the enterprises	X	X	X				X	X	X	X
3.1. Adjusting the system of education to the needs of the labor market	X					X				X
3.2. Development of skills, qualifications and competences of the human resources of regional economy and administration	X	X				X	X	X	X	X
3.3. Strengthening the culture of cooperation and social innovations			X			X	X			X
4.1. Development of internationalization of the enterprises	X	X						X	X	X
4.2. Economic promotion of the region	X	X								X
4.3. Development of internationalization of regional scientific-research units		X								X
Horizontal goal 1: Evolution of regional economy towards Industry 4.0	X	X	X		X		X	X		X
Horizontal goal 2: Transformation of enterprises allow for implementing the solutions in circular economy scope, including bio-economy	X	X	X	X			X	X	X	X
Horizontal goal 3: Improvement of monitoring instruments for progress of implementation the pro-innovative policy and functioning of innovation ecosystem including identification of bottlenecks for innovation diffusion	X									

Source: own study

9 Conclusions of the ex ante evaluation of RIS of the Podkarpackie Province[230]

The project of the Regional Innovation Strategy of the Podkarpackie Province has been evaluated by external contractors. The document was analyzed in terms of fulfilling the following criteria: relevance, consistency, effectiveness and efficiency.

The evaluators highly rated the RIS of the Podkarpackie Province project as a document enabling consistent building of the innovation system. The strategy fulfils the ex ante criteria of European funds, thus opening up the possibility of spending European funds in the region. It was also pointed out that RIS of the Podkarpackie Province not only identifies the problems and challenges of the province, but also precisely indicates the directions of development aimed at increasing the level of innovation and competitiveness of the region.

The experts also paid attention to the positive reaction of the stakeholders to the project being subject to consultation, especially to the mapping the innovation system. Precise definitions of the role of the individual actors in the regional innovation system, their position in the system is more legible.

The authors of the report emphasised that the objectives for the creation of the development of the economic system in the province were realized successfully. The Regional Innovation Strategy is an extensive plan to strengthen the competitiveness of the economy that is based on innovation, but also takes traditional sectors into account.

Conducting ex-ante evaluation made it possible to formulate conclusions and recommendations regarding the e.g., the introduction of appropriate modifications or additions to the document, the aim of which is to improve the quality of the Strategy. The results are presented in the table below. Each recommendation contains a reference to how it was incorporated into the final version of RIS of the Podkarpackie Province.

[230] Chapter created on the basis of the report from the study *Ewaluacja ex ante projektu Regionalnej Strategii Innowacji Województwa Podkarpackiego na lata 2021-2030* developed by a team led by University of Warsaw Professor W. Dziemianowicz, PhD, comp. Dziemianowicz W., Cybulska M., Bafeltowski D., Goliński J., Płaczek D., Tomczak N., Turosz S., *Ewaluacja ex ante projektu Regionalnej Strategii Innowacji Województwa Podkarpackiego na lata 2021-2030,* Warsaw 2021.

Table 20. Main conclusions and recommendations from the ex ante evaluation complete with reference[231]

Conclusion 1	In general, the Regional Innovation Strategy accurately responds to the challenges and needs of the Podkarpackie Province area that are related strictly to innovation, although some shortcomings are noticeable, also in the field of general economic and social issues, which may have at least an indirect impact on the area of innovation.
Evaluator's recommendation	Considering the completion of the directional part of the document with: • ehe role of NGOs in RIS building (especially action 1.2), • enhancement of interregional cooperation.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	The entire document, but with particular emphasis on the level of operational goals and implementation activities (Chapter 7. Vision, mission and strategic goals of RIS of the Podkarpackie Province).
Recommended implementing arrangements	Supplement.
Reference to recommendations	NGOs have been included as an important element of the innovation system within the social sector (i.e. associations and foundations). To avoid any misunderstandings, the final version of the document includes a definition of associations and foundations that are understood in the document as non-governmental oganizations. In addition, they will be included in the action dedicated to strengthening cooperation within the innovation system. The directional part of the strategy will be supplemented by an area related to the development of interregional cooperation.
Conclusion 2	Diagnosis of the regional innovation system correctly defines the needs and challenges of the region related to innovativeness.The identified deficiencies in the content of the diagnosis do not directly fit into the economic nature of the Strategy.
Evaluator's recommendation	Leaving the current thematic scope of the diagnosis unchanged.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 3. Diagnosis of the regional innovation system.
Recommended implementing arrangements	–
Reference to recommendations	No reference required.
Conclusion 3	Operational goals meet some of the SMART criteria, but they lack complete precision and the basis for determining the possibility of full implementation.

[231] Conclusions and recommendations were reflecting the order of the chapters that has been modified during the preparation of the final version of RIS of the Podkarpackie Province, comp. *Ewaluacja ex-ante*…, op. cit.

Evaluator's recommendation	Consider clarifying the names of parts of the operational goals.	At the stage of updating the existing system for the monitoring of RIS of the Podkarpackie Province, consider the estimation of the target values of indicators or determining the expected trends of changes in the perspective of 2030 (increase/decrease).
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Part of chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province (related to it by other parts of the strategy – e.g. monitoring system).	
Recommended implementing arrangements	Modification.	Supplement.
Reference to recommendations	The goals names have been modified to more accurately indicate the expected target state. In addition, a synthetic description of the scope of individual strategic and operational goals has been added.	The monitoring system has been supplemented with the expected trends of changes for individual indicators.
Conclusion 4	Main goal and strategic goals can be really achieved, although one should bear in mind the effectiveness of implementation of the document and effective system functioning.	
Evaluator's recommendation	Consider the clarification/renaming parts of the strategic goals (currently continuous and unfinished).	Consider analysis and evaluation of existing international practices in the field of active involvement of stakeholders in the process of document implementation and the use of possible conclusions at the stage of document implementation.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Part of chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.	
Recommended implementing arrangements	Modification.	Identification, analysis and evaluation.
Reference to recommendations	The goals names have been modified to more accurately indicate the expected target state.	Due to the time required to carry out such analyses, they will most likely be conducted on the implementation stage of RIS of the Podkarpackie Province.
Conclusion 5	The implementation activities indicated in the RIS of the Podkarpackie Province project will enable the development of the innovation system, although current directions of development can be expanded, what can strengthen their positive impact on building an efficient innovation system.	
Evaluator's recommendation	Consider supplementing the activities with a cooperation dimension of all groups forming a quadruple helix, i.e. local government and non-governmental organizations.	

Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Part of chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	Supplement.
Reference to recommendations	Implementation activities in the area of strengthening the innovation system were supplemented with missing elements of the helix.
Conclusion 6	Realization system RIS of the Podkarpackie Province in the institutional dimension is very extensive and well defined (groups of entities and even single entities have the actions ascribed as resulting from the goals). However the idea of an approach to the smart specialisations as the element of all parts of quadraple helix is not emphasized too well.
Evaluator's recommendation	Consider the following changes in the document: • deletion of Figure 34 and development of Figure 35 to identify smart specialisations; • consistent addition of SSs in the description of entities in the Chapter 8.1, and in Table 11.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 8.1. Entities involved in the implementation and realization of the RIS of the Podkarpackie Province and their role in the innovation system.
Recommended implementing arrangements	Modification/supplement.
Reference to recommendations	The stakeholders who create the individual elements of the quadruple helix are also stakeholders of the region's smart specialisations. As a result of the recommendation, this aspect was emphasized both in the diagram presenting the construction of the Podkarpackie innovation system, as well as in the matrix of activities planned for implementation under the RIS of the Podkarpackie Province.
Conclusion 7	The implementation system of the RIS of the Prodkarpackie Province seems to be exemplary, but the success of the described process will largely depend on the effectiveness of the 'new opening' of PIC and the translation of the activities of this body into the real shape of the instruments implementing RIS of the Podkarpackie Province.
Evaluator's recommendation	Consider the following changes in the document: • shift of the diagnostic content from the Chapter 8.3. to a new Chapter 3.4. The entrepreneurial discovery process in 2014-2020; • introduction of the provisions on the principles of implementation of the EDP to the Chpter 8.3. and their translation into instruments for the implementation of the RIS of the Podkarpackie Province. In addition, it would be worthwhile to indicate the actions within EDP, which will be continued in the period 2021-2030 (it is now presented only from historical perspective).
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 8.3. The entrepreneurial discovery process.

Recommended implementing arrangements	Content transfer/supplement.	
Reference to recommendations	The content related to the implementation of the EDP have been moved to the diagnostic part of the strategy. At the same time, Chapter 8.3 was expanded with the synthetic description of the activities under the EDP, planned for implementation in 2021-2030. The framework principles of its functioning have been indicated, as well as instruments for the implementation of the EDP.	
Conclusion 8	The RIS of the Podkarpackie Province implementation system contains a short Chapter 8.4. Implementation instruments, which is more suited to Chapter 9.2., which discusses the financial framework (it should be treated as an integral part of the delivery system).	
Evaluator's recommendation	Consider transferring the content of Chapter 8.4 to Chapter 9.2.	
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 8.4. Implementation instruments.	
Recommended implementing arrangements	Content transfer.	
Reference to recommendations	The provisions of the chapter on implementation instruments have been included in the provisions of the chapter titled 'Financial framework of the RIS of the Podkarpackie Province'.	
Conclusion 9	The monitoring system described in RIS of the Podkarpackie Province generally provides an assessment of progress in the implementation of the strategy, but some aspects of it need to be developed at the stage of updating the current and separate document, i.e. monitoring system of the RIS3 of the Podkarpackie Province.	
Evaluator's recommendation	Consider supplementing the monitoring system with: • indicators from databases created for the scientific evaluation (as a replacement for declaration-based indicators), • Detailing of some issues/ indicators – e.g. entrepreneurs' questions about 3.0 and 3.5 technologies, • baseline values, target values or expected trends of changes of ratios – on the stage of updating the monitoring systems, • wider reference to international level in the field of monitoring smart specialisations by extending benchmarking to all SSs.	Consider an analysis and evaluation of existing international active practices that involve stakeholders in the process of monitoring the strategy, as well as using possible conclusions at the stage of implementation and monitoring of the document.

Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 9.1. Monitoring system of the RIS of the Podkarpackie Province.	
Recommended implementing arrangements	Supplement.	Identification, analysis and evaluation.
Reference to recommendations	Indicators were reanalysed in terms of their reliability, repeatability and data sources. The system of monitoring was completed with expected trends of changes for particular ratios. Benchmarking has been extended to all smart specialisations. The rules for monitoring will be further clarified at the stage of implementation of RIS of the Podkarpackie Province.	Due to the time required to carry out such analyses, they will be most likely conducted during the phase of implementation of the RIS of the Podkarpackie Province.
Conclusion 10	The presented financial system is prepared in as much detail as possible for the time when RIS of the Podkarpackie Province was developed.	
Evaluator's recommendation	Consider supplementing the sources of financing specifically with budgets of local governments, the Local Government of Region, NCBiR and PFR funds.	
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 9.2. Financial framework of the RIS of the Podkarpackie Province	
Recommended implementing arrangements	Supplement.	
Reference to recommendations	The financial framework has been supplemented by the indicated sources of funding, with the provision that it is impossible to indicating even approximate values of such support.	
Conclusion 11	RIS of the Podkarpackie Province achieves high level of conformity with the superior documents on the European, national and regional level.	
Evaluator's recommendation	Leave the existing provisions at the level of goals in the thematic scope (after changes as a result of public consultations).	
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.	
Recommended implementing arrangements	–	
Reference to recommendations	No reference required.	

Conclusion 12	RIS of the Podkarpackie Province achieves a high level of compliance with the guidelines for the new programming period.
Evaluator's recommendation	Leave the existing provisions at the level of goals in the thematic scope (after changes as a result of public consultations).
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	–
Reference to recommendations	No reference required.
Conclusion 13	RIS of the Podkarpackie Province achieves a high level of compliance with key EU and national policies and strategies but achieving a high level of external potential utilization will require effective cooperation within the innovation system of the province.
Evaluator's recommendation	Leave the existing provisions at the level of goals in the thematic scope (after changes as a result of public consultations).
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	–
Reference to recommendations	No reference required.
Conclusion 14	The goals and activities aimed at their implementation are fully consistent with the provisions of the Regional Development Strategy.
Evaluator's recommendation	Leave the existing records at the level of goals and activities (apart from the suggested additions in the field of implementation activities resulting from other analyses).
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	–
Reference to recommendations	No reference required.
Conclusion 15	The document is internally coherent and logical, also no serious deviations in the linguistic correctness were identified.
Evaluator's recommendation	General text editing is recommended in the scope indicated in the Chapter 6.5.

Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Entire document.
Recommended implementing arrangements	Edition.
Reference to recommendations	The text has been corrected as suggested.
Conclusion 16	The main goal, strategic goals and vision are consistent with each other.
Evaluator's recommendation	Leave the existing records related to vision and goals.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	–
Reference to recommendations	No reference required.
Conclusion 17	Not all factors contained in SWOT analysis result directly from the diagnosis.
Evaluator's recommendation	Harmonize the relationship between diagnosis and SWOT analysis or supplementing information on how to prepare a SWOT analysis.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 3. Diagnosis of the regional innovation system. Chapter 5. SWOT analysis.
Recommended implementing arrangements	Modification/supplement.
Reference to recommendations	The provisions of the SWOT analysis were supplemented with missing elements raised in the diagnosis (regarding demographic factors, the impact of the COVID-19 pandemic on economic development and the financial results of innovative activities). In addition, this part of the strategy has been supplemented with information concerning the scope of the SWOT analysis preparation method.
Conclusion 18	The operational goals set out in the RSI HR shall be consistent and complementary.
Evaluator's recommendation	Consider a combination of operational goals 3.1 and 3.2, which are complementary to a large extent and present complementary issues in the field of the regional labour market.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Part of chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.

Recommended implementing arrangements	Modification.
Reference to recommendations	Goals 3.1 and 3.2 concern slightly different areas, which is why the agreement adopted so far has been left. Goal 3.1 focuses on activities related to the education of future staff, while Goal 3.2 focuses on areas related to the development of human resources through participation in a wide variety of physical activities. In order to avoid misunderstandings, a synthetic description of all strategic and operational goals has been added, in accordance with Recommendation No. 19.
Conclusion 19	The analysis of strategic, operational and implementation goals is difficult due to the lack of descriptions of individual parts. Concise, and therefore very economical approach to the records of goals is physically but on the other hand cause some inaccuracies and doubts: • for goals similar thematically (see point 18) – clarification of the differences between the different goals would clarify the need to separate certain contents; • for all goals – making it more difficult to assess the progress of the Strategy (see point. 3rd and points 4.); • for all goals and actions – a description of the goals would increase legibility and clarify possible shortcomings in terms of individual topics.
Evaluator's recommendation	Consider adding synthetic descriptions of strategic and operational goals, which will increase the clarity of the document and explain some issues.
Fragment of the RIS of the Podkarpackie Province project recommendation relates to	Chapter 7. Vision, mission and strategic goals of the RIS of the Podkarpackie Province.
Recommended implementing arrangements	Supplement.
Reference to recommendations	In accordance with the recommendation, a synthetic description of the scope of individual strategic and operational goals has been added.

Source: own study

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Work on the *Regional Innovation Strategy of the Podkarpackie Province for 2021-2030* was conducted under the direction of the Board of the Podkarpackie Province of the sixth term composed of: Władysław Ortyl – Marshal of the Podkarpackie Province, Ewa Draus – Deputy Marshal of the Podkarpackie Province, Piotr Pilch – Deputy Marshal of the Podkarpackie Province, Anna Huk – Member of the Board of the Podkarpackie Province and Stanisław Kruczek – Member of the Board of the Podkarpackie Province.

Preparation of RIS of the Podkarpackie Province was conducted with participation and under the content-related supervision by University of Białystok Professor Bogusław Plawgo, PhD, acting as an external expert for the development of the Strategy.

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