Regional Innovation Strategy of the Małopolska Region 2030

Marshal's Office of the Małopolska Region

Department of Ownership Supervision and Economy

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The works on the Regional Innovation Strategy of the Małopolska Region 2030 were conducted under the supervision of the Board of the Małopolska Region composed of:

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List o abbreviations

AGH – Stanisław Staszic University of Science and Technology in Kraków (Akademia Górniczo–Hutnicza);

AI – Artificial Intelligence (Sztuczna Inteligencja);

B+R (+I) – Research and Development (and Innovation) (Badania i Rozwój (i Innowacje));

BERD – Business Expenditure on Research and Development (Wydatki Przedsiębiorstw na Badania i Rozwój);

BIM Building Information Modelling – a set of technologies, tools and methods for the effective use of information in construction investment and building management (Modelowanie Informacji o Budynku);

CP1 – Policy Objective 1 "A smarter Europe – innovative and smart economic transformation" within the thematic concentration set out in the Regulation on the European Regional Development Fund and on the Cohesion Fund[1] (Cel Polityki 1);

DIH – Digital Innovation Hubs, i.e. organisations or teams of institutions the task of which will be to support enterprises in implementing and using Industry 4.0 solutions (Huby Innowacji Cyfrowych);

DZPO – Operational Programmes Management Department of UMWM (Departament Zarządzania Programami Operacyjnymi);

GERD – Gross Domestic Expenditure on Research and Development / Gross Domestic Funds on Research and Development (Wydatki Krajowe Brutto na Badania i Rozwój/ Nakłady Krajowe Brutto na Działanośc Badawczą i Rozwojową);

GUS – Statistics Poland (Główny Urząd Statystyczny);

ICT – Information and communication technologies (Technologie Informacyjne i Komunikacyjne);

IS – Smart Specialisation(s) (Inteligentna/e Specjalizacja/e);

IT – Information Technology (Technologia informacyjna);

JST – Local Government Unit (Jednostka Samorządu Terytorialnego);

IOB – Business Environment Institutions (Instytucje Otoczenia Biznesu);

KE – European Commission (Komisja Europejska);

KIS – National Smart Specialisation (Krajowa Inteligentna Specjalizacja);

KPO – National Operational Programmes (Krajowe Programy Operacyjne);

KPT – Kraków Technology Park Co.Ltd. (Krakowski Park Technologiczny sp. z o.o.)

KSRR – National Strategy for Regional Development (Krajowa Strategia Rozwoju Regionalnego);

MPI – Małopolska Investment Plan 2015–2023 (Małopolski Plan Inwestycyjny na lata 2015–2023);

MARR – Małopolska Regional Development Agency S.A (Małopolska Agencja Rozwoju Regionalnego S.A.);

MORR – Regional Development Observatory of the Małopolska Region (Małopolskie Obserwatorium Rozwoju Regionalnego);

MŚP – Micro, Small and Medium–sized Enterprise Sector (Sektor Mikro, Małych i Średnich Przedsiębiorstw);

OECD – Organisation for Economic Co–operation and Development (Organizacja Współpracy Gospodarczej i Rozwoju);

OZE – renewable energy sources (odnawialne źródła energii);

PARP – Polish Agency for Entreprise Development (Polska Agencja Rozwoju Przedsiębiorczości);

PFR – Polish Development Fund (Polski Fundusz Rozwoju);

PKB – Gross Domestic Product (Produkt Krajowy Brutto);

PKD – Polish Classification of Activity (Polska Klasyfikacja Działalności);

POIR – Smart Growth Operational Programme (Program Operacyjny Inteligentny Rozwój);

[1] See: (https://eur–lex.europa.eu/resource.html?uri=cellar:8d2f7140–6375–11e8–ab9c–01aa75ed71a1.0006.03/DOC_1&format=PDF), [access: 04.01.2021].

POKL – Operational Programme Human Capital (Program Operacyjny Kapitał Ludzki);

PPO – Entrepreneurial Discovery Process (Proces Przedsiębiorczego Odkrywania);

RIS3 – Research and Innovation Strategies for Smart Specialisation (Strategie badań i innowacji na rzecz inteligentnej specializacji) . An alternative term for this document – used mainly in Chapter 8 – highlighting its fulfilment of the assumptions for smart specialisation strategies. The relations between RSI WM 2030 and RIS3 are illustrated in Figure 1;

RPO WM – Regional Operational Programme for the Małopolska Region 2014–2020 (Regionalny Program Operacyjny Województwa Małopolskiego 2014–2020);

RSI WM 2020 – Regional Innovation Strategy of the Małopolska Region 2020 (Regionalna Strategia Innowacji Województwa Małopolskiego 2020);

RSI WM 2030 – the document in question (przedmiotowy dokument);

SC – Seed Capital (Kapitał Zalążkowy);

SIiEG – Strategy for Innovation and Efficiency of the Economy "Dynamic Poland 2020" (Strategia Innowacyjności i Efektywności Gospodarki „Dynamiczna Polska 2020”);

SOR – Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030) (Strategia na rzecz Odpowiedzialnego Rozwoju do roku 2020 (z perspektywą do 2030 r.));

SRWM 2030 – Development Strategy of the Region "Małopolska 2030" (Strategia Rozwoju Województwa „Małopolska 2030”);

SSC – Shared Service Centers (centra usług wspólnych);

UE – European Union (Unia Europejska);

UEK – University of Economics in Kraków (Uniwersytet Ekonomiczny w Krakowie);

UJ – Jagiellonian University in Kraków (Uniwersytet Jagielloński w Krakowie);

UMWM – the Marshal's Office of the Małopolska Region (Urząd Marszałkowski Województwa Małopolskiego);

VC – Venture Capital (Kapitał Wysokiego Ryzyka);

WM – the Małopolska Region (Województwo Małopolskie);

ZWM – the Board of the Małopolska Region (Zarząd Województwa Małopolskiego).

Explanation of terms used in the Strategy[2]

DOMAIN – description of IS at the first level of detail (the most general one); in the Małopolska Region there are 7 domains to be distinguished:

- **RIS 1** – Regional Smart Specialisation: Life science[3];
- **RIS 2** – Regional Smart Specialisation: Sustainable energy;
- **RIS 3** – Regional Smart Specialisation: Information and communication technologies (ICT);
- **RIS 4** – Regional Smart Specialisation: Chemistry;
- **RIS 5** – Regional Smart Specialisation: Production of metals, metal products and non–metallic mineral products;
- **RIS 6** – Regional Smart Specialisation: Electrical engineering and machine industry;
- **RIS 7** – Regional Smart Specialisation: Creative and leisure industries.

SECTOR – a group of economic entities and institutions constituting their immediate environment (e.g. scientific entities, IOB) that produce or support the production of similar products or provide (support the provision of) services of a similar nature; a sector is broader than an industry.

INDUSTRY – a branch of the economy that is narrower than a sector; industries are distinguished within a given sector (they are components of the sector).

FIELD – description of IS at the second level of detail (more detailed than a domain); in the Małopolska Region, 55 domains are distinguished:

- 9 under the domain of Life science;
- 6 under the domain of Sustainable energy;
- 15 under the domain of Information and communication technologies (ICT);
- 9 under the domain of Chemistry;
- 5 under the domain of Production of metals, metal products and non–metallic mineral products;
- 7 under the domain of Electrical engineering and machine industry;
- 4 under the domain of Creative and leisure industries.

In the case of the IS, one can distinguish between fields with an **industry**, **technological** and **industry–technological** character. In addition, there are also areas with a clearly cross–cutting specificity, which are referred to as **umbrella or horizontal**.

IS Working Group **–** according to the assumptions of UMWM, a forum for cooperation between the Małopolska Region and companies as well as other participants of the innovation system. They are to help adjust the innovation policy of the Małopolska Region to the needs of businesses, universities, research and development units, business environment and innovation users. The main subject of the work for the Groups is the smart specialisations of the Małopolska Region (their clarification, indication of the development directions and the most promising niches in which private and public funds intended for the growth of innovation should be invested). The Groups are also a place for animating cooperation between businesses and the scientific sector in order to improve knowledge transfer and commercialization of research results. The Groups continue, the so–called, Entrepreneurial Discovery Process in the Małopolska Region, and the results of their work, after consultation with the MRI (Małopolska Innovation Council), are presented to the Board of the Małopolska Region. There are 8 working groups in the Małopolska Region – 7 dedicated to IS and 1 having an interdisciplinary nature.

PPO – The Entrepreneurial Discovery Process is about selecting priorities and allocating resources through the participation of entrepreneurial stakeholders (e.g. companies, universities, public research institutes, independent innovators) who should identify the most promising areas for future regional development. This process is meant to demonstrate what a region or country does best in the field of research, development and innovation (B+R+I), in line with the assumption that it is the entrepreneurial stakeholders who have the best knowledge or can most accurately identify what the strengths of their activities are. This process usually occurs through a trial and error method and experiments with new activities. Regions must therefore "go out" to entrepreneurs and involve them in strategy designing, offering incentives for risk–taking.

Value chain – according to M. Porter's original proposal, this concept is used as a tool for analysing the competitiveness of a single enterprise[4]. The chain is a metaphor for all the important processes, into which the company's activity can be "broken down" in order to understand, on the one hand, how costs arise in the course of activity and to identify existing or potential fields in which the company can

[2] Complementary or related terms have been grouped together. As a result, the catalogue does not maintain alphabetical order.
[3] The term is also used in the plural: "*sciences*". However, due to the perpetuation of the name LifeScience Kraków Cluster in the region, which is strongly identified with the domain, and for practical reasons, the Strategy will consistently use the phrase "*Life science"*, which is also lexically justified.
[4] M.E. Porter, *Przewaga Konkurencyjna. Osiąganie i Utrzymywanie Lepszych Wyników,* Wydawnictwo HELION, Gliwice 2006.

distinguish itself from its competitors, on the other. According to Porter, competitive advantage is gained by those companies that are able to run these important processes cheaper or better than their competitors. The term value chain refers to all activities that are undertaken by companies and employees from the moment a product (good or service) is created until its final use, and which altogether determine the value the company provides to its environment.

GVC – Global Value Chain; we refer to it when the value chain is shared between multiple companies and geographies. These include activities such as designing, production, marketing, distribution and end–consumer support. These activities are coordinated globally to create values. The chain is usually divided into an upstream and a downstream section. The upstream one includes producers of raw materials and intermediate products and suppliers of the company. The downstream chain starts with the company producing the final product, passes through distributors/retailers and ends with the end customer. Today, GVCs are a dominant component of global trade and investment, spanning the economies of developed, developing and emerging countries.

BPO (within the business services sector) – providers of services to external customers, primarily within the following areas: finance and accounting, customer service, HR and payroll services as well as administration related to the purchasing process.

SSC (within the business services sector) – Shared Service Centres created within a single corporation, providing services primarily in the following areas: finance and accounting, human resources, purchasing departments and IT support for internal clients.

Benchmarking – a method of improvement used in management (e.g. of local government units), consisting in comparing processes and practices and relating such ones to model solutions.

GOZ – circular economy; GOZ is a concept that aims to rationally use resources and limit the negative environmental impact of manufactured products. This model aims to minimise the consumption of raw materials and the generation of waste, and thus reduce emissions and energy consumption levels, by creating a closed loop of processes, in which the waste generated is treated as raw materials in subsequent production stages.

IT (within the business services sector) – providers of IT services for external clients (domestic and foreign) – IT outsourcing in the area of hardware, infrastructure, software development, implementations and systems integration, including development centres of companies, the main activity of which includes the creation, implementation and sale of software.

IoT – Internet of Things or Intelligence of Things – one of the more recent IT concepts. It consists in connecting tangible objects with each other and with Internet resources. Such a system of electronic devices communicates automatically and exchanges data via a network without human intervention.

OZE – renewable energy sources – renewable, non–fossil energy sources including wind energy, solar energy, aero thermal energy, geothermal energy, hydrothermal energy, hydropower, wave, current and tidal energy, energy from biomass, biogas, agricultural biogas and bioliquids[5]. In the context of the future use of OZE[6], which is included in the draft Energy Policy for Poland until 2040, hydrogen energy (referred to as "green" when obtained from OZE) in the form of gas or energy storage should be mentioned.

R&D (within business services sector) – companies conducting research and product development as well as application and software development, includes internal departments of companies whose main activity is not selling software.

RII – regional innovation index – a complex indicator integrating 17 measures, used by the European Commission in analyses to be reported in the periodical Regional Innovation Scoreboard.

TOWS – a strategic analysis technique used to examine the internal conditions and environment of an organisation (e.g. local government unit). TOWS is a variant of SWOT analysis (acronym of words indicating the analysed dimensions – Strengths, Weaknesses, Opportunities, Threats), shifting the importance to external (exogenous) factors.

Design thinking – the process for creative development of design concepts.

Service design – the process of arriving at the scope and shape of a service procedure, involving its target customers.

[5] In accordance with the Renewable Energy Sources Act of 20.02.2015 (consolidated text, Journal of Laws 2020, item 261).
[6] (https://www.gov.pl/web/klimat/projekt–polityki–energetycznej–polski–do–2040–r), [accessed: 16.12.2020].

1. Regional Innovation Strategy of the Małopolska Region (RSI WM 2030) within the strategic programming system

The status of regional innovation strategies in the system of strategic programming is defined by the Act of 6th December 2006 on the principles of conducting development policy (Journal of Laws of 2019, item 1295, as amended), which structures the principles of running development policy, entities conducting this policy and the mode of cooperation between them as well as the Development Management System of Poland referring to it[7]. In this context, the Regional Innovation Strategy of the Małopolska Region (RSI WM 2030) is complementary to the following strategic documents from the **national level:**

- **Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030)**[8], it was adopted by the Council of Ministers on 14 February 2017. The SOR is an update of the country's medium–term development strategy, i.e. the Country Development Strategy 2020, and remains the binding key document of the Polish state in the area of medium– and long–term economic policy;
- **National Strategy for Regional Development 2030**, which develops the provisions of the Strategy for Responsible Development for the period up to 2020 (including the perspective up to 2030)[9] defined in the pillar: socially sensitive and territorially balanced development. KSRR constitutes the basic strategic document of the state regional policy
  in the perspective until 2030;
- **Productivity Strategy[10] (including annexes)**[11], which constitutes an update of the Strategy for Innovation and Efficiency of the Economy (SIiEG) and has been enriched with new elements, building a modern economy, based on knowledge and innovative digital technologies, while using the advantages resulting from the natural conditions of the country and the limitations resulting from such ones. At the same time, the Productivity Strategy 2030 is one of the nine integrated strategies that detail the provisions of the Strategy for Responsible Development. The Strategy defines the directions of intervention and support instruments used by the state in the years to come in order to stimulate the growth of investment level and productivity of enterprises. The main objective of the proposed Strategy is a progressive increase in productivity in the conditions of the economy being: climate neutral, of closed circulation, based on data.

For the **regional level**, the complementary nature refers to:

- **Development Strategy of the Region "Małopolska 2030"**[12] **(SRWM 2030),** which is an update to the Development Strategy of the Małopolska Region for 2011–2020

[7] Adopted by Resolution No. 162/2018 of the Council of Ministers of 29 October 2018.
[8] See (https://www.gov.pl/web/fundusze–regiony/informacje–o–strategii–na–rzecz–odpowiedzialnego–rozwoju), [accessed 25.09.2020].
[9] See (https://www.gov.pl/web/fundusze–regiony/krajowa–strategia–rozwoju–regionalnego), [accessed 25.09.2020].
[10] See (https://www.gov.pl/web/rozwoj–praca–technologia/konsultacje–publiczne–projektu–strategii–produktywnosci–2031), [accessed: 07.10.2020].
A public consultation on this strategy document is currently underway.
[11] This concerns 4 annexes: Diagnosis, National Smart Specialisation, Criteria for selection of strategic industries, Fulfilment of basic conditionality for 2021–2027.
[12] The document was proceeded in parallel with RSI WM 2030 and was finally adopted during the XXXI Session of the Assembly of the Małopolska Region on 17 December 2020; cf. (https://www.malopolska.pl/strategia–2030/projekt–srWM–2030) [accessed: 04.01.2021].

(SRWM 2011–2020). At that time, the Regional Innovation Strategy of the Małopolska Region 2020 (RSI WM 2020) was one of 10 strategic programmes to the Development Strategy of the Małopolska Region 2011–2020, developed by the Małopolska Region local government[13].

In addition, the complementary nature includes contextual documents (in relation to RSI WM 2030) both from the **European level, e.g. :**

- Recovery plan for Europe[14];
- European Green Deal[15];
- Directive (EU) 2019/1161 of the European Parliament and of the Council of 20th June 2019 amending Directive 2009/33/EC on the promotion of clean and energy–efficient road transport vehicles[16];
- Directive (EU) 2019/944 of the European Parliament and of the Council of 5th June 2019 on common rules for the internal market in electricity and amending Directive 2012/27/EU[17];

as well as the national one , such as:

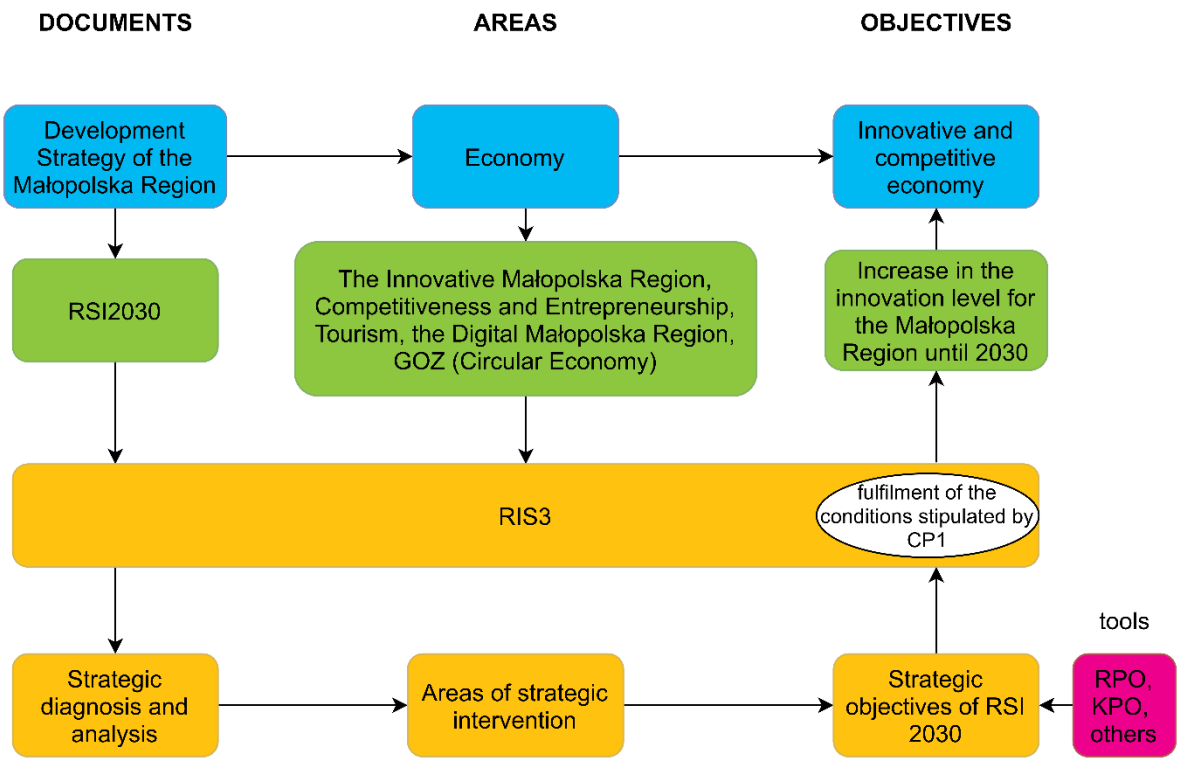
- Directions for Cluster Policy Development in Poland after 2020[18],
- Digital Competence Development Programme until 2030[19];
- National Broadband Plan[20];
- National cyber security system[21];
- Roadmap – Transformation towards a circular economy[22];
- Draft of the Act amending the Act on e–mobility and alternative fuels as well as certain other acts[23].

[13] Cf. Regional Innovation Strategy of the Małopolska Region 2020 (https://www.malopolska.pl/biznes/innowacje/regionalna–strategia–innowacji) [accessed 04.01.2021].
[14] (https://ec.europa.eu/info/live–work–travel–eu/health/coronavirus–response/recovery–plan–Europe_pl), [accessed: 25.09.2020].
[15] (https://ec.europa.eu/info/strategy/priorities–2019–2024/European–green–deal_pl), [accessed: 25.09.2020].
[16] OJ EU L 188 of 12.07.2019, p. 116.
[17] OJ EU L 158, 14.06.2019, p. 125.
[18] (https://www.gov.pl/web/rozwoj–praca–technologia/krajowe–klastry–kluczowe), [accessed: 25.09.2020].
[19] (https://www.gov.pl/web/cyfryzacja/kompetencje–cyfrowe), [accessed: 25.09.2020].
[20] (https://www.gov.pl/web/cyfryzacja/narodowy–plan–szerokopasmowy), [accessed: 25.09.2020].
[21] (https://www.gov.pl/web/cyfryzacja/krajowy–system–cyberbezpieczenstwa–). [accessed: 25.09.2020].
[22] (https://www.gov.pl/web/rozwoj–praca–technologia/gospodarka–o–obiegu–zamknietym), [accessed: 25.09.2020].
[23] Submitted for public consultation 20.11.2020.

2. Affiliations between RSI WM 2030 and the Development Strategy of the Małopolska Region 2030

In the context of the regional policy, the Development Strategy of the Małopolska Region 2030 remains the superior document in relation to the present Strategy. This means that the RSI WM 2030 should be compliant to the assumptions of the superior document and the objectives adopted therein should be consistent with the objectives of the SRWM 2030 and support the implementation of such ones. The reference point for this Strategy is the objective formulated in the SRWM 2030 in the area of Economy (Innovative and competitive economy). The activities undertaken in the RSI are to contribute to its achievement and additionally will create the basis for fulfilling by the Małopolska Region the conditions for obtaining support within the new EU perspective 2021–2027 (Policy Objective 1 – A smarter Europe – innovative and smart economic transformation). At the heart of the intervention undertaken within the framework of the RSI WM 2030 lie the assumptions of smart specialisation strategies – RIS3. Therefore, the catalogue containing the directions of measures included in the SRWM 2030 with regards to innovation, entrepreneurship, competitiveness, digitisation or tourism determines the framework within which RSI performs the necessary contextualisation, prioritisation, detailing and complementation from the perspective of RIS3. These relationships are explained in the diagram below.

Figure 1. Implementation of the RSI WM 2030 in the context of the SRWM 2030



The review of assumptions and activity directions planned in the SRWM 2030 leads also to the conclusion of a complementary and potentially supportive role of the RSI WM 2030 in relation to other, apart from the Economy, areas of the SRWM 2030 (Małopolanie [the Małopolska Region population], Environment, Strategic development management, Territorially sustainable development). These affiliations can be used by the region, e.g. while selecting the topics for planned competitions, shaping the competition preferences, etc.

3. Theoretical context regarding the works on the RSI WM 2030 and the main assumptions for the strategy under development

The development of the RSI WM 2030 assumptions has benefited from the experience originating from three types of sources (perspectives) that influence the final character of this document and the solutions proposed therein with regard to IS management and coordination of regional PPO. These sources include:

- previous experience, based on own assumptions as well as IS and PPO activities within the RSI WM 2020 implemented on the basis of them **(regional perspective – own)**;
- In parallel to the implementation activities carried out at the national and regional level in the EU, there is an EU–wide scientific reflection on the theoretical foundations related to the concepts of IS and PPO. One of the most important elements of these considerations is the issue of (global) value chains as a well–established concept describing international trade or the internationalisation of enterprises in terms of OECD[24], World Trade Organisation[25] or World Bank[26] and simultaneously supporting the analysis (including monitoring) regarding IS and PPO **(scientific perspective)**;
- various experiences of external nature (regional, national and international) concerning IS and PPO within the financial perspective 2014–2020, which were summarized, inter alia, in the conducted evaluation studies commissioned by PARP and numerous publications by the Joint Research Centre[27] (this applies, inter alia, to the analyses in the scope of IS management in the context of the global value chains concept) or institutions involved in building the system of IS and PPO in the EU **(implementation perspective)**.

The aforementioned sources contribute to the fact (in contrast to the situation characterising the previous EU financial perspective 2014–2020, when most regions and countries were only gaining their first experience in formulating and implementing the RIS3 policy) that it is now possible to use the accumulated knowledge and experience in developing the RIS assumptions and designing the IS and PPO system in the region within the financial perspective 2021–2027.

An additional element, of a different nature than the three above–mentioned perspectives, concerns the requirements for IS and PPO imposed on the regions within the new financial perspective (2021–2027) by the European Commission. They are described in Annex No. 4 to the Draft Productivity Strategy 2030 – Report on Poland's fulfilment of the basic conditionality called "Good management of the national or regional strategy for smart specialisation within the framework of Policy Objective 1 A smarter Europe – innovative and smart economic transformation under the Cohesion Policy 2021–2027".

[24] Cf. OECD, *Participation of developing countries in global value chains. Implications for Trade and Trade–Related Policies*, Summary Paper, 2015; OECD, *Innovation–driven Growth in Regions: The Role of Smart Specialisation*, 2013.
[25] Cf. D. K. Elms, P. Low, *Global value chains in a changing world*, WTO, 2013.
[26] Cf. A. Dieppe, *Global Productivity. Trends, Drivers, and Policies*, World Bank Group, 2020; A. Mattoo, N. Rocha, M. Ruta, *Handbook of Deep Trade Agreements*, World Bank Group, 2020.
[27] The JRC is the European Commission's in–house science service. Its research provides independent, evidence–based advice to EU policies. See (https://ec.europa.eu/info/departments/joint–research–centre_pl), [accessed: 25.09.2020].

Experience regarding IS and PPO within the Małopolska Region (regional – own perspective)

As for the previous experiences of the region in the field of IS and PPO, such ones were summarised in the "Mid–term evaluation regarding the implementation of the Regional Innovation Strategy for the Małopolska Region 2020". This study primarily identified difficulties related to the proper definition of IS – both in the context of communication with stakeholders and the theoretical assumptions on which they are based. A significant problem was also too extensive definition of IS, which resulted in the existence of as many as 255 elements at the third level of detail in the description of the seven IS in the Małopolska Region. Although this guaranteed fast disbursement of funds under the RPO WM (which positively distinguished the region from others in Poland), it led to erroneous perception of IS as an extremely capacious idea (accommodating almost every project or covering all activities for entrepreneurs, state research units or IOB in the region). Attention was also drawn to the approach used in RSI monitoring – the evaluation recommendations suggested focusing primarily on the level of results from pro–innovative activities carried out in the region, which was reflected in the new form of monitoring proposed in this document (chapter 8). The dependencies between the way IS was formulated and detailed and the dynamics of PPO (including, but not limited to, the lack of effectiveness of the so–called "experimentation mechanism", included in the RSI WM 2020) were highlighted. In the case of the PPO, **the main recommendation was to depart from the monitoring system conducted by the bodies established for this purpose (in particular, IS working groups) and favour the tracking of the natural activity of entities, which, as shown, inter alia, by international experience, guarantees greater efficiency and effectiveness**. In addition, a number of consultations carried out during the works over the Strategy accepted and catalogued comments from the partners of UMWM and institutions involved in the implementation of the innovation policy in the region. Potentially highly useful were, for example, experiences related to the functioning of support schemes offered in the RSI (positive assessment of the voucher formula – e.g. innovation vouchers, training vouchers), the possibility of using the regranting formula, designing support instruments with the participation from entrepreneurs (e.g. with the use of design thinking or service design) or completing the catalogue of tools (acceleration programmes).

IS and PPO strategies in the light of the reference bibliography, including the concept of value chains (academic perspective)

IS and PPO, already after the first implementation processes, became a subject of scientific research. In particular, it is worth noting those findings which inclusion in the process of designing a new regional RIS3 strategy may serve to increase the relevance, internal coherence and effectiveness of interventions. They were complemented by a literature review on strategic programming, carried out with a view to improving the process and preventing the risks to which it is exposed. The first decision related to this issue was to narrow down the strategic diagnosis to selected areas on which the planned intervention is to be based (they are described below, in chapter 4). The diagnosis was conducted in relation to the potential, but also trends and dynamics of the phenomena affecting the development of economic sectors included in the domains of the Małopolska region IS[28]. Further, attention was drawn to

[28] Cf. T. Kudłacz, *Programowanie strategiczne na szczeblu terytorialnym w Polsce. Spostrzeżenia dotyczące praktyki w kontekście wartości instrumentalnych dla polityki rozwoju*, „Studia Ekonomiczne. Gospodarka. Społeczeństwo, Środowisko", 2018, nr 1(2).

the most characteristic challenges related to the first years of experience in implementing RIS3 and PPO in European regions. These include: 1) too strong concentration of PPO on B+R[29], in relation to the need to search for real, region–specific drivers for development, 2) omission of the role of Global value chains (GVCs) in IS design, leading to a limitation of perspectives and initiatives related to the cooperation outside the region, 3) insufficient emphasis on the development of institutional capabilities, and 4) difficulties in implementation, related to the need to reconcile the dynamic nature of IS and PPO with, relatively rigid, political and administrative requirements and conditions[30]. The need to strengthen interregional and international initiatives and projects is highlighted in a number of publications and case studies[31], and therefore the emphasis in the Strategy on cooperation in the broad sense is clear, while the issue of internationalisation was not limited to a separate objective, but was made one of the main principles for the development of support instruments. Another important theme in the literature is the cooperation in the implementation of RIS3 and the organisation of PPO between the region's authorities and local authorities, e.g. county, city[32]. It was (especially in relation to Kraków) already raised in the mid–term evaluation of the RSI WM 2020 and was taken into account in while working on the RSI WM 2030. Institutional solutions facilitating the implementation of RIS3 are an important issue for the planned Strategy. In this context, an important issue is, among others, the role of regional innovation agencies – specialised units responsible for innovation policy[33] that are partly independent[34] of regional authorities. In the light of attempts to test within the Małopolska Region the solutions aimed at decentralisation of PPO and the existence of various institutions in the region partly fulfilling the function of such agencies, their better use within support schemes, including in the financial dimension (regranting), requires reflection. Moreover, one of the most important issues in relation to the effectiveness of the RIS3 type strategy seems to be the maintenance of balance and coherence between the adopted general assumptions as well as strategic objectives and the implementation instruments (the so–called policy mix)[35], related to e.g. the formula of support offered by the region, types of competitions, competition criteria, applied incentives etc. As many studies and evaluations show, it is at this stage when the potential inherent in the well outlined objectives is "blocked". The planned Strategy assumes – adjusted to the operational possibilities of the region – openness to change, periodic updating of support conditions and better adjusting it to the needs demonstrated by the representatives of the IS domains and conclusions of the conducted diagnosis.

One of the most important thematic areas, present in the scientific reflection on the implementation of IS and PPO, central for the assumptions made in the Strategy, are value chains, to which more attention should be devoted here. They constitute one of the

[29] This leads to the creation of "islands" or "niches of B+R excellence" for which the challenge is to connect appropriately with the environment, cf. S. Radosevic, A. Curaj, P. Gheorghiu, L. Andreescu, I. Wade, (eds.), *Advances in the Theory and Practice of Smart Specialisation*, Elsevier 2017, p. 24.
[30] Ibid.
[31] K. Koschatzky, H. Kroll*, Multi–level governance in regional innovation systems,* in: EKONOMIAZ. Revista vasca de Economía, Gobierno Vasco / Eusko Jaurlaritza / Basque Government, 2009, vol. 70(01), pp. 132–149.C. Cohen, *Implementing Smart Specialisation: An analysis of practices across Europe* (No. JRC118729), Seville: Joint Research Centre, 2019.
[32] M. Estensoro, M. Larrea, *Overcoming policy making problems in smart specialisation strategies: engaging subregional governments*, in European Planning Studies, 2016, (DOI: 10.1080/09654313.2016.1174670).
[33] A. Morisson, M. Doussineau, *Regional innovation governance and place–based policies: design, implementation and implications*, in Regional Studies, Regional Science, 2019, 6:1, 101–116, (DOI: 10.1080/21681376.2019.1578257).
[34]This should be understood more as – at least partial – autonomy of action rather than lack of formal dependence.
[35] H. Kroll (2015), *Efforts to Implement Smart Specialisation in Practice – Leading Unlike Horses to the Water,* European Planning Studies, 2015, 23:10, 2079–2098, (DOI:10.1080/09654313.2014.1003036), H. Kroll, *Eye to eye with the innovation paradox: why smart specialisation is no simple solution to policy design*, 2019, European Planning Studies, (DOI: 10.1080/09654313.2019.1577363).

underestimated concepts of strategic management in Poland, which was formulated by M. Porter as early as in the 1980s and has been successively updated and developed[36]. Some of its elements and achievements in the form of GVC analyses used e.g. in the analysis of international trade and intra–industry exchange[37], were referred to by the European Commission at the stage of designing solutions in the field of smart specialisation within the financial perspective 2014–2020. Both the literature (Joint Research Centre[38] publications), as well as European Commission documents, clearly emphasise the need to take into account the international and interregional dimensions in the approach to smart specialisation. At the same time, technological modernisation is strongly dependent on countries and regions using GVCs, linkages and international R&D networks as growth "levers" as well as learning mechanisms.

References to value chains were present, inter alia, within the European Commission's guidelines for "National/Regional Innovation Strategies for Smart Specialisation (RIS3)" of 2014[39]. In the context of increasing the "visibility" of regions for international investors, it was recommended to focus on what provides the region with the greatest competitive potential, and smart specialisation helps to establish the region's position in specific global markets/niches and in international value chains. Furthermore, when improving a region's external relations, it is necessary to improve internal relations in parallel, which has long been a hallmark of innovation policy (e.g. triple or quadruple "helixes", knowledge triangles, university–firm cooperation, clusters, etc.). At the same time, regions need to be increasingly open to external relations in order to position themselves in European and global value chains and to improve their relations and cooperation with other regions, clusters and innovation actors. This bears importance for the internationalisation of companies in order to achieve the right potential for cluster activities and the inflow of new knowledge into the region. Recommendations in this regard include[40]:

- selecting the GVCs best suited to the regional B+R+I potential as well as production capacity or services;
- developing ways to support regional entrepreneurs in climbing the ladder, moving from a process to a product and improving functions or the value chain;
- discovering, for existing capabilities, new opportunities for development, production or market applications not foreseen by foreign and local partners. This process relies on the interaction between the lead company's GVC and the local supplier, but is also shaped by the B+R+I infrastructure support that companies can rely on.

Considering the reflection carried out in relation to value chains, it is necessary to recall the IS criteria proposed by Gianelli and co–authors[41] , which stress the close link between value chains and IS. Importantly, however, IS is not limited to this aspect only. Indeed, the proposed criteria cover a wider scope. They aim to assess whether a specialisation proposal meets the

[36] J. Borowski, *Łańcuch wartości jako nowa teoria zarządzania strategicznego*, „Optimum. Studia Ekonomiczne", 2013, nr 2 (62).
[37] Cf. Organisation for Economic Cooperation and Development (OECD) (2007). *Moving Up the Value chain: Staying Competitive in the Global Economy*. Main Findings. Paris: OECD.
[38] E.g. A. Mariussen, R. Rakhmatullin, L. Stanionyte, *Smart Specialisation Creating Growth through Trans–national cooperation and value chains,* JRC, 2016; L. Brennan, R. Rakhmatullin, *Global value chains and Smart Specialisation Strategy, JRC* 2015; E. Todeva, R. Rakhmatullin, *Industry Global value chains, Connectivity and Regional Smart Specialisation in Europe*, JRC, 2016.
[39] Cf. (https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/smart_specialisation_pl.pdf), [accessed 25.09.2020].
[40] Cf. S. Radosevic, K. Ciampi Stancova, *External dimensions of smart specialisation: Opportunities and challenges for trans–regional and transnational collaboration in the EU–13*, S3 Working Paper Series No 09/2015.
[41] C. Gianelle, F. Guzzo, K. Mieszkowski, *Smart Specialisation: what gets lost in translation from concept to practice?* , Regional Studies, 2019, (DOI: 10.1080/00343404.2019.1607970).

requirements of indicating a development priority in the sense of "smart specialisation" and concern the determination of:

- the sectors or value chains on which the intervention will focus;
- the application of technology that will lead to the transformation/development of the sector;
- the social challenges to which the IS is responding;
- natural and/or cultural resources on which specialisation can be 'founded'.

While developing the document entitled RSI WM 2030, all the above mentioned criteria were taken into account, although value chains remain the basic axis around which the developed IS diagnosis, IS monitoring scheme, PPO assumptions and proposals for supporting IS areas in the Małopolska Region are concentrated.

Value chain in RSI – according to Porter's[42] original proposal, this concept is used as a tool for analysing the competitiveness of a single enterprise. The chain is a metaphor for all the important processes into which a company's activity can be "decomposed" in order to understand, on the one hand, the emergence of costs in the course of activity, and, on the other, to identify existing or potential fields of differentiation. According to Porter, competitive advantage is gained by those companies that are able to run these important processes cheaper or better than their competition.

Porter himself distinguished nine processes grouped into two types of enterprise value activities, i.e. providing customer value: core (logistics in procurement, operations, logistics in distribution, marketing and sales, service and after–sales) and support (company infrastructure, technology development, human resource management and procurement)[43]. These categories (creatively developed by different authors and organisations) can be used to precisely design support for companies, responding to their needs for strengthening competitiveness.

Simplifying, we can say that contemporary value chains of enterprises (from the perspective of their customers) include three main groups of processes: innovation processes (identification of needs, design, creation of an offer), operational processes (production and delivery of products or services) and after–sales processes[44].

In the conditions of global economy, the concept of a value chain is considered more broadly than within the boundaries of a company. Chains "decompose" into groups of enterprises that interact with each other in order to meet the needs of the buyer with the help of a product/service. In this way, we can distinguish between the internal chain – the enterprise and the external chain – its suppliers, distributors, customers[45]. Distinguishing the activities of the company (functions, areas) enables a strategic analysis of the processes that determine the competitive advantage of an entity (or a group of similar entities) in a given market. In turn, the analysis of the "external" value chain is the starting point for the study of global value chains, which are a significant part of modern world trade[46].

The concept of a value chain is sometimes confused or used interchangeably with e.g. commodity chain, supply chain or logistic chain. This approach is not entirely justified, although, as indicated by researchers into chain relations in the economy, the boundaries between these concepts are fuzzy and blurred[47] in specific applications. From the perspective of the diagnosis and strategic analysis it should be stressed that the concept of a value chain is more general and applicable than the concepts of supply chain or logistic chain, which allows it to be used not only to describe the actual connections of economic entities in the region, but, above all, to analyse the sources of competitive advantage behind the concept of smart specialisation. It is not surprising that value chains are more and more often a point of reference in strategic documents and analyses of the regions developing their smart specialisation strategies (e.g. the Zachodniopomorskie Region, the Podlaskie Region and the Mazowieckie Region).

[42]M.E. Porter, op. cit.
[43] J. Borowski, op. cit.

For the aforementioned reasons and for the purpose of developing the RSI WM 2030, the following assumptions were accepted regarding the application of the value chain concept:

1) The primary value chain approach in the study is Porter's original concept, which (a) links directly to an emphasis on the sources of corporate competitiveness and the delivery of value to the customer, (b) allows for a clear reference to innovation, and (c) demonstrates usefulness also beyond the single entity perspective;
2) The study avoids reference to specific, well–defined products/services and their supply chains, maintaining the necessary level of generality inherent in the strategy;
3) The term chain is used in the study in three different contexts:

a) as a model of valuable activities (in Porter's terms), allowing the use in the analysis of different categories of activities connected with an actual or potential increase in competitiveness and innovativeness of the Małopolska Region enterprises,

b) as a generalisation of the valuable activity model within the so–called economic path of the sector, i.e. a set of interacting actors, each of which has an impact on the value chain of the others[48] and

c) possible directions of coordination or reinforcement of chain elements within the framework of public intervention planned within RSI. Activities planned within the framework of RSI will focus on the use of measures adapted to the characteristics of value chains and needs specific to particular domains of IS.

Despite the fact that the concept of value chains in relation to IS is not well established in Poland (both at regional and national levels), this does not mean that it is completely absent. Exceptions are such regions as the Mazowieckie[49] or the Zachodniopomorskie[50], which referred to this concept within their Regional Innovation Strategy or conducted research under the financial perspective 2014–2020. In the case of the National Smart Specialisations (KIS), it was assumed, among other things, that "(...) after the final elaboration of 16 regional strategies for smart specialisation, a map will be developed indicating the geographical location of national and regional smart specialisations on the map of Poland as well as the entities

[44] Cf. T. Rojek, *Koncepcja łańcucha wartości w zarządzaniu przedsiębiorstwem*, „Zeszyty Naukowe Uniwersytetu Szczecińskiego", 2014, nr 803, „Finanse, Rynki Finansowe, Ubezpieczenia" nr 66, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin , pp. 813–822.
[45] Cf. M. Frankowska, , *Łańcuch logistyczny, łańcuch dostaw i łańcuch wartości – próba usystematyzowania koncepcji*, „Zeszyty Naukowe Uniwersytetu Szczecińskiego. Problemy transportu i logistyki", 2015, nr 31, pp. 77–91.
[46] Cf. J. Góra, *Globalne łańcuchy wartości jako narzędzie badania globalizacji*, „Organizacja i Kierowanie", 2013, nr 2 (155).
[47] Ibid. It is worth noting that the development of forms of collaboration between companies, including their cooperation, is one of the most important factors that make it difficult to clearly define different types of chains and the boundaries between them, and the fact of the possibility and legitimacy of their co–creation, in particular from the point of view of regional competitiveness, should also be taken into account within the framework of strategic planning of support for entities covered by the intervention of RSI WM 2030.
[48] Cf. T. Rojek, op. cit.
[49] See (https://innowacyjni.mazovia.pl/publikacje/raport–z–badania–identyfikacja–lancuchow–wartosci–w–obszarach–inteligentnych–specjalizacji–mazowsza.html), [accessed 25.09.2050].
[50] See (http://smart.wzp.pl/inteligentne–specjalizacje/lancuchy–wartosci), [accessed: 25.09.2020].

directly related to the development of a given area of B+R+I and its place in the value chain will be identified"[51].

The aforementioned considerations lead to a clear conclusion that value chains are an integral part of the management system (including monitoring) of IS and PPO, and, as shown by the analyses carried out under the 2014–2020 financial perspective, they are one of the elements that should be taken into account when designing the regional IS system under the 2021–2027 perspective. This requirement is met by the developed RSI WM 2030.

External experiences of IS and PPO gained by institutions involved in IS and PPO system building in the EU (at the national level and the European Commission – implementation perspective, from policy makers' point of view)

As far as external experience is concerned, it was gained primarily through the research carried out on commission of the Joint Research Centre analysing, inter alia, the implementation of IS and PPO[52] (also in the context of global chains)[53] as well as PARP. In the case of the latter institution, the following analyses should be indicated:

- summarising activities in the field of IS and PPO at the national level and focusing on the analysis of synergies of smart specialisation strategies, IS monitoring systems, and PPO implemented at the central (KIS) and regional level (16 RIS). The mid–term evaluation of the Non–Competitive Project entitled "Monitoring of the National Smart Specialisation" within the Smart Growth Operational Programme 2014–2020, developed in this regard, showed primarily the lack of sufficient organisational and institutional coordination between RIS and KIS;
- benchmarking of IS monitoring systems in Poland, which allowed, first of all, to review (inventory of) selected solutions (including good practices), applied in 16 Polish regions and concerning management of the process of regional IS monitoring as well as coordination of PPO;
- benchmarking of IS and PPO monitoring systems at the international level, which allowed to identify good practices in IS and PPO management among innovation leaders in Europe and countries similar – in innovation–related dimensions – to Poland.

The research made it possible to compare the Małopolska Region IS system to other regional, national and international solutions, in particular in terms of their effectiveness and efficiency. They were taken into account in the current RSI WM 2030.

New financial perspective 2021–2027

An additional set of assumptions used in the Strategy is related to the new financial perspective (2021–2027) and, in particular, it concerns the CP1 criteria. These are the general criteria applicable to the thematic baseline condition, as formulated in the draft 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 as well as the financial rules applicable to these Funds

[51] See Annex Number 4 – *National Smart Specialisation (KIS)* (https://www.smart.gov.pl/images/pdf/Krajowa–inteligentna–specjalizacja_0.pdf), [accessed: 25.09.2020].
[52] Examples include C. Cohen, *Implementing Smart Specialisation: An analysis of practices across Europe* (No. JRC118729), Seville: Joint Research Centre, 2019.
[53] This includes issues such as: (i) Internationalisation of the regional/national economy and positioning in European value chains; (ii) S3P – Industry partnerships; (iii) Pilot of adriatic–ionian macroregional smart specialisation strategy.

and to the Asylum and Migration Fund, the Internal Security Fund and the Border Management and Visa Instrument[54]. The criteria to be met for the baseline condition mean that the smart specialisation strategy(s) should be supported by:

- Up–to–date analysis of bottlenecks to the diffusion of innovation, including digitisation;
- Existence of a relevant regional/national institution or body responsible for managing the smart specialisation strategy;
- Monitoring and evaluation tools to measure effectiveness in achieving the strategy objectives;
- Effective functioning of the Entrepreneurial Discovery Process;
- Actions to improve national and regional research and innovation systems;
- Action to manage industrial transformation;
- Measures for international cooperation.

Consequences for the RSI WM 2030

Summarising the above–described overview of experiences and different perspectives on the implementation of IS policies, the following main assumptions guiding the updated Strategy can be pointed out:

The starting point for the Strategy includes the Małopolska Region IS, the dynamics of development for their respective domains and the specifics related to such ones;

- Diagnosing and using the potential lying in the specificity of the Małopolska Region IS make use of the concept of the value chain, including GVC. Proposed instruments of support, especially addressed to entrepreneurs, should refer to this specificity and differentiate them due to elements of the value chain appropriate for the needs diagnosed;
- The strategy takes into account the hitherto experiences of European regions in the implementation of RIS3*,* emphasising, inter alia, active intra– and interregional cooperation, internationalisation of activities and more accurate and flexible design of support instruments "closer" to the beneficiaries;
- Changing the approach to monitoring IS and innovation in the region taking into account the key role of PPO;
- Decentralise PPO[55] by animating autonomous, open specialisation platforms;
- Regular, ongoing influence of PPO participants on the development of projects, initiatives and modifications to the terms and conditions of support provided under the RSI during the period of its validity;
- The implementation of RSI is conducive to achieving the objectives of SRWM 2030 in the area of economy.

[54] See (https://eur–lex.europa.eu/legal–content/PL/TXT/?uri=COM%3A2018%3A375%3AFIN), [accessed 25.09.2020].
[55] Decentralising the process means prioritising the recognition, use and strengthening of existing networks of institutions, links, business relationships, etc. over the creation of completely new structures, organisations or institutions. The idea of the "new PPO" and specialisation platforms is presented in more detail in Chapters 6 and 8.

4. Diagnosis in the domains of the Małopolska Region smart specialisations

Pursuant to the aforementioned principle of focusing the diagnosis on the areas defining the planned intervention, objectives and measures, the attention in the diagnosis concentrated on the situation in the seven domains of Małopolska IS[56]. Their scopes have been regularly verified in the recent years, but indicator, econometric and qualitative analyses[57] do not give unambiguous prerequisites for extending or narrowing the catalogue. Therefore, the diagnosis starts from the current domains, while the PPO launched simultaneously in the region gives an opportunity (and even widely opens opportunities) for their corrections, which should be reflected in the future updates of the diagnostic part of the RIS document.

On the scale of regional economy and labour market, the share and importance of specialisation domains are considerable. Slightly more than ¼ of all employees in the region work in industries classified as IS, and their share is growing. The growth concerns all sub–regions and most poviats (counties). The percentage of people working in smart specialisation sectors significantly influences the value of GDP per capita. At the same time, the percentage of new entrants in IS sectors positively influences the value of GDP per capita. In addition, a statistically significant positive impact of EU–funded projects supporting smart specialisation sectors on GDP per capita in the Małopolska Region poviats (counties) was identified[58].

The diagnosis adopts a uniform layout, taking into account the already mentioned perception of value chains. The description of each domain starts with an indication of the scope and general nature of specialisation. Then, on the basis of the IS Specification made during the work of the IS Working Groups, an attempt was made to indicate the value chains within the specialisation domains, they were referred to from the perspective of IS monitoring and actually implemented projects, financed within the framework of the RSI WM 2020, the potential of specialisation and its inclusion in Global value chains was discussed and current trends and niches analysed, taking into account the impact of the COVID–19 epidemic[59] on specialisations. The diagnostic description of each domain concludes with an analysis of benefits, barriers, difficulties and needs from the perspective of the specialisation stakeholders.

The strategic diagnosis in the domains of specialisations was complemented by a TOWS analysis, extended by the impact of the phenomena occurring in the areas of education, entrepreneurship and digitisation on the Małopolska Region IS. This analysis, which has an auxiliary character, was used primarily as a tool to organise the work and conclusions of the consultations and workshops conducted. Its results (Annex No. 1) were taken into account in the formulation of the areas for intervention and strategic objectives.

[56] The adoption of a specialisation system (seven initial specialisation domains) in the diagnosis allows, by referring to the results of IS monitoring and analyses of the impact of IS on the Małopolska Region economy, to take into account the territorial dimension of specialisation, including the diversity of development potential and needs between the parts of the region.

[57] The verification analyses are available at: (https://www.malopolska.pl/biznes/innowacje/badania–i–analizy), [accessed: 04.01.2021].

[58] (https://www.malopolska.pl/publikacje/gospodarka/pomiar–wplywu–inteligentnej–specjalizacji–na–rozwoj–gospodarczy–malopolski–edycja–2020), [accessed: 04.01.2021].

[59] Although in the period of development of the Strategy the shock that affected the global economy was associated with the COVID–19 epidemic, which is directly referred to by the authors of the document, the observations and conclusions presented in these subsections highlight the specificity of smart specialisations, which may also be valid in the face of other shocks (which is related to, for example, the consequences of disruption to supply chains for industries related to the specialisation). It should also be pointed out that some of the economic impacts of COVID–19 may be multi–year or permanent.

The next chapter (5 – Strategic analysis in IS domains) summarises and prioritises the diagnostic findings, guiding the planning part of the document.

Contextual information for the IS monitoring results presented:

Conclusions for the monitoring of projects compliant to the Małopolska Region IS, submitted to the RPO WM were developed on the basis of the database representing the state as of mid–2020. The said database relied on applications and signed agreements for RPO Axis I and III, in which IS affiliation was required and rewarded, respectively. Applicants must/can associate their project with at least one IS at its lowest, third, level of detail. However, the conclusions for the diagnosis were drawn with reference to the second level – the field level. Applicants were not limited as to the number of affiliations, however a single mapping remained the standard (55% of cases). Multiple mappings could refer to other fields within the domain or/and outside the domain, which allowed us to analyse the coherence of the specialisations and their actual internal and external links. The analysis took into account the order of the mappings (provided by the applicant), i.e. the first indication was the reference point for inferring the links – this approach made it possible to avoid considering the same links several times. In the analysed database there were 908 ongoing projects (exclusively related to at least one field), assigned to a total of 1736 fields, and 1728 complex projects (exclusively related to at least one field), assigned to 3403 fields.

Diagnosis in the domain of Life science

Scope and general nature of the specialisation

IS Life science is one of the broadest and most internally diversified (in terms of, inter alia, fields of knowledge and science used, technologies applied, nature of core activity of companies, types of products and services offered) specialisations of the region. This broad scope, hidden behind the domain generally referred to as "Life science", has for years been a challenge for attempts to verify[60] this specialisation of the region on the basis of general economic and industry data that could unify the methodology of its analysis in relation to the other IS of the region. The rationale for choosing a specialisation is therefore verified primarily through an analysis of B+R expenditures (by a field of science), the profile of operating SC and VC funds or the percentage of students of medical, biological and agricultural faculties[61].

Recent verification analyses devoted to this IS of the Małopolska Region omitted, among others, the pharmaceutical industry in division 21 of section C of PKD, which at the same time was analysed under IS Chemistry. Meanwhile, the description of the domains of the Małopolska Region specialisations made in 2014[62] came up with a different mapping (PKD 21 as part of the IS Life science, while Chemistry was exclusively under PKD 20). Among the activities "associated" with the specialisation were PKD codes related to the following divisions and classes: 21 – Manufacturing of basic pharmaceutical substances and drugs and other pharmaceutical products, 71.20.A – Research and analysis related to food quality, 72.11.Z – Research and development in the field of biotechnology, 72.19.Z – Research and development in other natural and technical sciences, 75.00.Z – Veterinary activities and 86 (health care, including the operations of hospitals and the practice of medicine as well as physiotherapy). Taking into account in the analysis of the region's potential the high availability of health care units, including hospitals, is – which is worth emphasizing – an element that strengthens the rationale for the indication within the Life science specialisation of the field devoted to Innovative Medical Centre (Innovative Hospital)[63]. It should be noted that the PKD division 21 belongs to "high technology" industries, and the whole division 72, covering, among others, scientific research and development works in the field of biotechnology or other natural and technical sciences, is "high technology services". In turn, divisions 75 – veterinary activities and 86 – health care belong to a different type of knowledge–based services. Hence, the Life science domain is mostly created by entities distinguished in terms of knowledge–intensity, innovation and B+R activity, so the **key activities and processes determining the generation of value and the position of entities from the Life science specialisation in**

[60] Cf. *Analiza weryfikacyjna obszarów inteligentnej specjalizacji regionalnej województwa małopolskiego,* Fundacja GAP, Kraków 2014 oraz M., Mitka, K. Oleksy, W. Onyśków, A. Otręba–Szklarczyk, D. Szklarczyk, *Aktualizacja pogłębionej diagnozy innowacyjności gospodarki Małopolski*, Fundacja Rozwoju Badań Społecznych, Kraków 2018 (https://www.malopolska.pl/_userfiles/uploads/Aktualizacja%20pog%C5%82%C4%99bionej%20diagnozy%20innowacyjno%C5%9Bci%20Ma%C5%82opolski%20(2018).pdf), [accessed: 08.09.2020].

[61] Ibid.

[62] *Charakterystyka dziedzin wytyczonych przez inteligentną specjalizację regionu,* Biostat 2014.

[63] As part of the study *Inteligentne specjalizacje województwa małopolskiego. Uszczegółowienie obszarów wskazanych w Regionalnej Strategii Innowacji Województwa Małopolskiego 2014–2020,* Kraków 2015. In the materials devoted to the description of the Małopolska Region IS to date, including the IS of Life science, however, there was no reference to the potential related to the access to high–quality medical practices, including dentistry, in the context of the development of the so–called medical tourism. Meanwhile, this clearly growing economic specialisation of Kraków, related to the IS of the region and strengthening its image as a "bioregion", has been recognised by the city authorities (and included, among others, in the Strategy for Tourism Development in Kraków for 2014–2020).

value chains are related to managing of: appropriate infrastructure, technology and human resources.

value chains from the perspective of the output of the RIS Working Groups

For IS Life science, on the basis of the materials developed by the Working Group corresponding to the specialisation, it is possible to speak of two main value chains (or rather two types, groups of such ones). The first one consists of "products and technologies used in the prevention, diagnosis, treatment and rehabilitation of human and animal diseases", included collectively under the heading "health and quality of life", the second one of "products and intermediate products used in the production of pharmaceuticals, cosmetics, food, materials and energy"[64] included under the heading "bioeconomy"[65]. This division expresses an orientation towards value creation from a point of view of:

- a customer – a potential patient (including a resident of the region or a person receiving treatment in the region) and
- the entities cooperating with the pharmaceutical industry, chemical industry (e.g. cosmetics), as well as with sectors that do not constitute the core of the specialisation, such as agriculture, food processing, power engineering or the water and sewage sector and land reclamation.

However, the overlapping nature of some specialisation areas (e.g. functional food and disease prevention or integrative medicine) makes **it reasonable to search for, create and strengthen value chains growing out of the fields** (indicated at the second level of detail, the specialisation, e.g. between field 1.1 Active and healthy life, 1.6 Healthy food and nutrition) **but also between the fields belonging to various domains** (e.g. 1.3. Modern diagnostics and therapy, Digital health, 1.4. New therapeutic technologies and supporting medical devices with IS Life science, 3.1. Medical engineering technologies, including medical biotechnologies, 3.2. Diagnostics and therapy of civilization diseases and personalized medicine with IS Information and communication technologies, 4.1. Chemistry in health care with IS Chemistry or 6.1. Medical engineering technologies with IS Electrical engineering and machine industry).

The state of distribution with regards to related, largely complementary (and sometimes inseparable) areas between different specialisations hinders the concentration of regional economic entities around existing value chains, independently diagnosed by the representatives of different specialisations. The process of their merging and integration, on the other hand, corresponds, *de facto,* to the transition from the region's economic specialisations to smart specialisations[66]. From the point of view of the first of the above–

[64] *Smart specialisations...*, op. cit, p. 6.

[65] The bioeconomy within the domain, in addition to the field of the same name, is also referred to by (at least) the field "Modern, sustainable agriculture" as e.g. a supplier of biomass or "Environment – environmental health factors", including e.g. wastewater treatment processes. The possibilities of searching for value chains between these fields and also with others (e.g. medicine) are evidenced by the results of the analysis of regional value chains related to the Biopolymers demonstration project, developed by the LifeScience Cluster Foundation (2019), a key representative of the specialisation, participating on behalf of the Małopolska Region in the cooperation network Avant–Garde Initiative. Due to the horizontal nature of the "bioeconomy" and its connection with the assumptions of the Circular Economy (GOZ), it is proposed to consider this aspect of regional smart specialisations separately.

[66] The new way of monitoring PPO and IS planned by the Małopolska Region, still at the pilot stage, based on "specialisation platforms" (cf. Detailed description of the subject matter of the contract for the provision of services entitled "Organisation of the management structure and animation of the Entrepreneurial Discovery Process within selected smart specialisation of the Małopolska Region (pilot rpogramme), (https://bip.malopolska.pl/umWM,a,1795755,organizacja–struktury–zarzadczej–i–animacja–procesu–przedsiebiorczego–odkrywania–w–ramach–wybranej–i.html), [accessed: 26.08.2020] and using multi–level data on entities, technologies, sources of knowledge and relations between them remains a step in the desired, described direction.

mentioned orientations in IS Life science (the ultimate buyer is a potential patient), due to the constant nature of customer needs, **the desired direction of specialisation development may include the integration of entities from different domains around the chains in which the value is associated with a) maintaining physical and mental well–being (prevention and diagnostics) and b) effective treatment and recovery (diagnostics, therapy, rehabilitation)**[67]. From the point of view of the second orientation (interaction with buyers representing various industries and market sectors at the B2B level), due to the high level of technological sophistication characteristic for the IS Life science, the variability of trends, customer needs and the current technological and business capabilities of the participants in the value chains, **it is necessary to analyse them in more detail with the participation from the entities forming the specialisation**[68]. **Tasks of this type will be able to be implemented in the form of the so–called specialisation platforms, if the planned pilot schemes regarding the new way of organising PPO in the region demonstrate such validity**.

Value chains from the perspective of IS monitoring

25 out of 224 projects for which the Life science domain was indicated by RPO beneficiaries (as of 1 July 2020) as the first assignment, were simultaneously linked by them to another field within the domain. The most frequent parallel linkage was recorded for the fields Healthy food and nutrition as well as Modern sustainable agriculture. **There were also 58 cases of simultaneous linking of a project with a field from another domain**. The field of Active and healthy living proved to be the most prone to interdisciplinary connections, with parallel links to Healthcare chemistry and Leisure industries, while the field of Healthy food and nutrition, with projects simultaneously implemented within Leisure Industries**. This information, together with the observations made above, may be a hint, for example, for profiling the competitions within the RPO, but also for selecting potential subjects or partnership proposals within the planned formula of the PPO (specialisation platforms)**.

The consistency of field categories in the Life science domain is low. Labels are sometimes vague (Active and healthy living), overly broad (Bioeconomy) or disproportionately specific (Innovative medical centre (Innovative hospital)). Additionally, taking into account that the fields are defined with reference to different orders (technological, quality of life, institutional designations), their catalogue may be perceived as moderately coherent. At the same time, the **functional diversity of the fields within the domain may provide an opportunity to search for and strengthen new value chains within its scope** (e.g. Innovative hospital, through the use of new technologies, may be an element strengthening the quality of life in the region).

Potential for specialisation in the light of monitoring and inclusion into GVCs

The structure of the number of projects[69] realised within the nine fields of specialisation is relatively balanced. Only one field (Healthy food and nutrition) is more than twice as successful

[67] An example of a serious and pressing challenge that should be discussed among specialisation stakeholders is the needs of the patients from disadvantaged groups, e.g. children and adolescents (in particular child psychiatry).
[68] An example of a successful project of this type is the already mentioned analysis of regional value chains for biopolymers, developed by the LifeScience Cluster Foundation (2019).
[69] Here and further, this formulation should be regarded as a narrative simplification. In fact, the structure of the number of assignments for projects to particular fields is analysed. In practice, projects are assigned from one (55% of cases), through two (24%), to even over a dozen (several cases) fields. This allocation is universal – it concerns the full set of project assignments within all 7 IS.

as the domain average, and for three fields the number of projects is less than half the average – the smallest number of projects was realised in the Innovative medical centre field. There was also a low supply of high quality projects in the Bioeconomy field, which is part of the Bioeconomy value chain, clearly separated within the domain, with only 14 projects (out of a total of 367 in the domain). On the other hand, Bioeconomy has an above average (53.8%), within the domain, success rate, i.e. the share of the number of projects selected in the number of applications. Applicants in the fields Medicinal products and medical devices, Healthy food and nutrition and Modern sustainable agriculture are more successful. The lowest rate (37.4%) is recorded for the field Modern diagnostics and therapy, Digital health.

The current innovation and development potential of the IS is shaped, to a large extent, by the operations of biotechnological companies, gaining a stronger and stronger position in the national and global value chains. It ought to be mentioned in this context, among others, about Selvita S.A. and the company separated from it in 2019 Ryvu Therapeutics S.A., focusing on the development of cancer therapies, IBSS Biomed S.A., Biophage Pharma S.A or F1 Pharma S.A. This development remains in line with the **global trend of pharmaceutical sector representatives outsourcing B+R and pre–clinical research, in which the Małopolska Region–based companies specialise**. Tycoons of the global pharmaceutical market are looking for services provided by a CRO (contract research organization) in the area of new drug discovery, among others. The **companies from the Małopolska Region cooperate with the world's leading Life science companies, including those from the pharmaceutical sector, which is a result of high quality services and the gradual acquisition of recognition and acknowledgment within the world market**. The sector itself (PKD division 21) is present in the region owing to foreign investments (TEVA Polska), but the core activity of this type is also conducted by IBSS Biomed S.A., achieving a leading position in the country (owing to the production of serums and vaccines) and selling its products in several dozens of countries worldwide.

The basis for developing the potential of the Małopolska Region entities in the field of discovery of therapies and medicines as well as their production is, above all, a developed and constantly expanded technical infrastructure[70] **and high quality human capital**[71]**, allowing to compete in GVCs with the help of B+R activities**. Although this is the dominant type of resource from a value creation perspective in the chain, it is worth noting that it is not the only one. Business models of entities are differentiated, e.g. IBSS Biomed, apart from the leading position on the vaccine manufacturing market in the country and the development of new products (B+R), cooperates with foreign contractors on the basis of contract manufacturing (production capacity). **Activeness within GVC is also carried out through management activities and enhancing business opportunities, e.g. by establishing new companies or acquisitions**. For example, Biomed is one of the four founders of Mabion S.A., which specialises in targeted oncology therapies, while Selvita is the founder and the main shareholder of Ardigen S.A., a fast–growing bioinformatics company, which uses the **advantages of AI and Big Data to generate medical knowledge**. The latter

[70] For example, Selvita plans to create a new Laboratory Services Centre in Kraków with an area of approximately 4,000 m^2 within the next 3 years, which means almost doubling the space currently used by the company in Kraków and Poznan (source: Selvita Group Strategy 2020–2023).
[71] In the Małopolska Region, students are educated at 8 universities and over 90 fields of studies related to medical technologies (cf *Technologie medyczne i farmaceutyczne. Potencjał innowacyjny Małopolski*, Klaster Life science, Kraków 2017).

direction of development is in line with the most relevant current trends in the development of Life science in the world and can have an impact on each element of the value chain[72].

Taking the above into account, **it is necessary to continue activities strengthening the key resources of actors from the Life science domain (education, tertiary education, cooperation with universities, smoothing the commercialisation of research results, technological infrastructure, B+R) and to strengthen cooperation in value chains** by animating smart specialisation around related fields, defined in the domains: Life science, Information and communication technologies, Chemistry, Electrical engineering and machine industry and (to some extent) Creative and leisure industries. Intra–regional cooperation of the medical, pharmaceutical, biotechnological or broadly understood Life science sector with IT, electrical engineering and machine industry companies may result in new opportunities resulting from, e.g. the previously described **boom related to data processing and bioinformatics**. At the same time, the implementation of products and services based on (largely sensitive) data, the personalisation of medical services or the development of telemedicine will increase the importance of **cyber security, which will become an indispensable element of the value chain**.

As far as the Małopolska Region's active business potential in the Life science domain is concerned, similarly to the fields of specialisation, attention should be paid to the **functional diversity of entities, enabling the creation of new value chains** (entities engaged in medical diagnostics, e–health, production of drugs and medical devices, clinical research and medical services, medical technologies, production of medical devices) and a significant share of entities engaged in the production of cosmetics (Active and healthy living)[73]. In addition to the aforementioned entities, there are at least two more leaders in their respective areas in Poland, i.e. Comarch Health Care S.A. and Silvermedia S.A.[74].

The high scientific potential of the Małopolska Region in the Life science domain has been repeatedly emphasised in analytical studies (e.g. updates of the innovation diagnosis of the region from 2015 and 2018). Nevertheless, **a constant challenge in the context of the sector's needs is maintaining an appropriate number of students of medical and Life science faculties**. The Małopolska Region Life science entrepreneurs have the possibility to cooperate with a total of a dozen universities or institutes from the domain of Life science. **The quality of research conducted and the effectiveness of scientific entities in obtaining funds for research is high**. The region has the largest number of scientific centres with the status of the Leading National Scientific Centre (KNOW)[75], of which two consortia belong to the Life science domain. **The role and international recognition of Małopolskie Centrum Biotechnologii UJ (the Małopolska Centre of Biotechnology at the Jagiellonian University) is also growing**[76]. The centre's experts are involved in international research on viruses, including the COVID–19. A very important role in the **internationalisation and networking of the specialisation's stakeholders is played by the Life science Cluster, one of 15 National Key Clusters**. It brings together the majority of innovative and dynamically developing entities from the Life science sector and sectors related to it by value chains (e.g. chemical, IT, professional services – legal), including the entities representing the world of

[72] *2020 Global Life science outlook. Creating new value, building blocks for the future,* Deloitte, 2020.
[73] Cf. *Technologie medyczne i farmaceutyczne…,* 2017, op. cit.
[74] Ibid.
[75] *Aktualizacja pogłębionej diagnozy*…, 2018, op. cit., pp. 63–64.
[76] The first studios and buildings of the MCB were put into operation as early as 2011, but we can speak of a full inauguration of activities and a gradual "start–up" since 2014.

entrepreneurs, science, business environment institutions, public administration or public healthcare. The cluster participates in international programs and projects (e.g. the Sano project – international research foundation, AMiCI project), networking projects (e.g. for European Life science clusters – Cluster Excellence for Business Innovation and Growth in the Health Sector), participates in the works of the Vanguard Initiative (Bioeconomy Pilot Project) and organizes and co–organizes events of international scope (e.g. EuroBioTech conference, Life science Open Space). **In addition to the strengths demonstrated by the companies within the sector which enable their inclusion into GVCs, in the Life science domain it is the networking of contacts on an international scale that provides a mechanism for strengthening their competitiveness**. A similar observation can be made in relation to networking conducted by the cluster at a regional level.

Trends, niches and development directions with the impact of the COVID–19 epidemic

The high interest in the competitions and the supply of projects in the field of healthy food and nutrition is part of a worldwide growing **trend towards healthy living, linked to a change in social awareness and, thus, in consumer needs and expectations. This trend may provide a basis for the development of a value chain focused on "healthy living prevention"**. However, further in–depth analysis is needed of the hitherto unused competition potential, in particular in relation to such areas where there were few applicants or a low success rate occurs.

The demand from global pharmaceutical industry leaders for high quality pre–clinical research and services will continue to grow. The development of bioinformatics and the increase in the use of AI in widely understood Life science will play a major role in the coming years. A niche that should therefore develop rapidly will be issues and technologies related to ensuring data security[77], which has already been highlighted in connection with the COVID–19 epidemic (particularly in the context of vaccine research[78]). The region's potential in the production of cosmetics and personal care products is also promising (although, from the point of view of public statistics, it is a part of the chemical industry). It is also worth highlighting the region's involvement and scientific development in the field of air quality protection, an issue potentially stimulating cooperation of entities from the said domain with the representatives of other Małopolska Region IS.

From the perspective of the ongoing COVID–19 epidemic, several factors shaping the situation of Life science entities can be pointed out. First of all, apart from healthcare, which takes on the risks associated with fighting an epidemic, this domain (including the pharmaceutical industry) has so far shown resilience to economic recessions[79] and economic fluctuations. **The pharmaceutical and biotechnology sector in times of epidemic appears as the so–called "potential saviour"**[80,81]. **The Małopolska Region has a potential in this respect**, e.g. a team from the Małopolska Centre Biotechnology at the Jagiellonian University led professor Krzysztof Pyrć, in collaboration with the NIZP–PZH team in Warsaw, isolated and

[77] *Life science innovation and security: Inseparable,* KPMG, 2017.
[78] Cf. *More promise, more problems: Cyber attacks threaten Life sciences companies researching COVID–19 vaccine* (https://realeconomy.rsmus.com/more–promise–more–problems–cyberattacks–threaten–life–sciences–companies–researching–covid–19–vaccine/), [accessed: 01.09.2020].
[79] Cf. (https://www.pulshr.pl/rynek–zdrowia/koronawirus–namieszal–w–branzy–life–science–menedzerowie–i–handlowcy–sfrustrowani,72663.html), [accessed: 01.09.2020].
[80] Cf. *The effect of a pandemic on the Life sciences industry* (https://www.fieldfisher.com/en/sectors/life–sciences/life–sciences–law–blog/the–effect–of–a–pandemic–on–the–life–sciences–indu), [accessed: 01.09.2020].
[81] Cf. *Coronavirus pandemic highlights importance of Life sciences industry* (https://realeconomy.rsmus.com/coronavirus–pandemic–highlights–importance–of–life–sciences–industry/), [accessed: 01.09.2020].

characterised SARS–CoV–2 from a sample taken from the first Polish patient to have been diagnosed with the infection (further samples are under study). The genome sequence will be made available in public databases for all scientists to use. A similar move was made by a team led by professor Marcin Drąg from the Wrocław University of Science and Technology. The researchers worked out an enzyme that is crucial in the fight against coronavirus and made the results of their widely reported work available to other scientists[82]. The industry is highly supported by EU in this regard[83]. Informative activities in the area of Covid–19 are also carried out by the Life science Cluster[84]. The support of the Life science industry in the fight against the pandemic concerns mainly: testing (including work on rapid and cheap testing of people for coronavirus) and work on the invention of a vaccine against coronavirus). Actors in the Life science domain, like in other economic domains, are vulnerable to supply chain disruptions. While demand factors are currently the strength of the global pharmaceutical industry, a major threat and challenge posed by the pandemic is the growing supply tensions. While in the innovation part of the sector, supply chains are quite stable and mainly concentrated in developed countries, in the generic segment (drugs, substances) they are much more fragile[85]. Supply disruptions, with relatively low stocks, threaten with shortages of some medicines, which can last for months. The problem relates mainly to cheap replacements for original medicines, and therefore affects access to many treatments for the poorest groups of consumers. In this context, it will be extremely important to effectively unblock international supply channels and to ensure the operational continuity of plants in the countries subject to restrictions related to pandemic containment[86]. **An increase in systemic support** (including ongoing work on a pharmaceutical strategy for Europe) **and closer cooperation between manufacturers of innovative vaccines and antiviral therapies as well as a likely increase in state spending on healthcare and products**[87] **should be taken into account**; companies with a portfolio of products intended for Intensive Care Units – especially patient intubation equipment and ventilators, but also those needed for serological and molecular testing – are in the best position. Funds for its purchase were secured by the State Treasury[88].

Undoubtedly, **COVID–19 is an additional stimulating factor for the development of Life science**[89], inter alia, in the context of the B+R area (cooperation of scientists within networking), clinical studies conducted and public support for the industry (e.g. from European funds). The funds will be earmarked for, among other things, medical supplies within the EU[90] and support for the healthcare sector[91]. The good condition of the Life science sector (in

[82] Cf. Skiba P., *SARS–CoV–2: branża LifeScience pokazuje światu siłę współpracy* (https://biotechnologia.pl/biotechnologia/sars–cov–2–branza–lifescience–pokazuje–swiatu–sile–wspolpracy,19617), [accessed: 01.09.2020].
[83] Cf. *Coronavirus vaccines strategy* (https://ec.europa.eu/info/live–work–travel–eu/health/coronavirus–response/public–health/coronavirus–vaccines–strategy_en), [accessed: 01.09.2020].
[84] Cf. *Serwis COVID–19*, (https://lifescience.pl/covid–19/). [accessed: 01.09.2020].
[85] This is because it is based on a just–in–time model and relies heavily on sub–suppliers from developing countries such as China and India.
[86] Cf. *Economy in times of pandemic. Gospodarka w czasach pandemii. Spojrzenie sektorowe na bazie pierwszych doświadczeń*, Pekao Bank, April 2020, (https://www.pekao.com.pl/o–banku/aktualnosci/084c4abc–018b–4af4–bb32–ee1c44236326/raport–banku–pekao–gospodarka–w–czasach–pandemii–spojrzenie–sektorowe–na–bazie–pierwszych–doswiadczen–globalnych/084c4abc–018b–4af4–bb32–ee1c44236326/raport–banku–pekao–gospodarka–w–czasach–pandemii–spojrzenie–sektorowe–na–bazie–pierwszych–doswiadczen–globalnych.html), [accessed: 01.09.2020].
[87] Cf. M. Wąsiński, D. Wnukowski, *Skutki pandemii COVID dla gospodarki światowej*, PISM, „Biuletyn", 2016, no. 84, 20 April 2020.
[88] Cf. *Branża Life science w czasie pandemii. Kto zyskuje, kto traci* (https://www.rynekaptek.pl/marketing–i–zarzadzanie/branza–life–science–w–czasie–pandemii–kto–zyskuje–kto–traci,37052.html), [accessed: 01.09.2020].
[89] Cf. *Life sciences in the Fight Against COVID–19* (https://ifwe.3ds.com/life–sciences/in–the–fight–against–covid–19), [accessed 01.09.2020].
[90] Cf. *COVID–19: gromadzi pierwsze w historii zapasy środków medycznych w ramach rescEU* (https://ec.europa.eu/commission/presscorner/detail/pl/ip_20_476), [accessed: 01.09.2020].
[91] Cf. *EU Health Emergency Support Facility – Questions and Answers* (https://ec.europa.eu/commission/presscorner/detail/pl/qanda_20_577), [accessed: 01.09.2020].

particular, the drug sector) is confirmed by the dynamic growth of the WIG–leki index[92] compared to the WIG index (an example of a large increase in value is Biomed Lublin, which started production of a drug against coronavirus). As far as the previously mentioned role of AI is concerned, **COVID–19 leads to intensification, on a global scale, of the use of modern technologies related to Big Data or AI in the area of Life science** e.g. in patient care (example of SIMULIA XFlow model [93]). AI can be the key tool in the fight against coronavirus – both in terms of forecasts regarding its spread and work on drug and vaccine development. There will also be **increased development of 'virtual health, including telemedicine**[94]. A Deloitte survey (2019/2020, conducted in the USA) shows that 50% of executives believe that by 2040 at least 25% of outpatient care, prevention, long–term care and wellbeing services will have been delivered remotely[95].

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

The representatives of entities from the IS domain are subject to a cyclic survey whose aim is, among others, to assess the implementation of the region's economic strategy based on the IS, to identify barriers and difficulties as well as the needs. Among the benefits of the activities addressed by the regions to the IS representatives, the possibility of establishing contacts, partnerships and consortia is indicated. The **quality of contacts between entrepreneurs and specialised units of universities improves, however higher efficiency of scientific institutions in sharing research results and their commercialisation is expected**. Information needs are emphasised at various levels – from the dissemination of the very assumptions of the IS, through the offer of financial support to advice on its use. The possibility to improve submitted applications before their final assessment is evaluated very positively. There is an expectation of changes in the financing of innovative projects related, among others, to the possibility of their termination at a certain stage of works without consequences or the possibility of settling (e.g. advance payments) with contractors directly from the project accounts held by an operator.

The representatives of specialisations connected with healthy food production indicate challenges connected with recruiting and keeping (seasonal) employees and the increasing costs of cultivation. **Small or individual inventors/innovators indicate problems with launching innovations on the market** – despite good ideas, they do not have sufficient resources, including the financial ones, to do so. A challenge for most entities is **an access to highly qualified staff (including talented students, graduates) and their retention**. On the other hand, for faster developing entities, the challenge is the lack of appropriate infrastructure, in particular laboratory space.

As a long–term growth factor, the IS representatives surveyed pointed to the consistent branding of Polish entities – in this respect, the functioning of the specialisation is beneficial, because it affects not only business, but also the awareness of the society, including potential contractors. Further active search for intelligent connections between topics, technologies and

[92] Cf. (https://www.bankier.pl/inwestowanie/profile/quote.html?symbol=WIG–LEKI) – as of 18.08.2020.
[93] Cf. *Battling the Coronavirus with SIMULIA XFlow* (https://blogs.3ds.com/simulia/battling–coronavirus–simulia–xflow/), [accessed:01.09.2020].
[94] Cf. (https://www2.deloitte.com/pl/pl/pages/press–releases/articles/telemedycyna–rewolucjonizuje–tradycyjne–modele–opieki–zdrowotnej.html), [accessed 01.09.2020]; The effect of a pandemic on the Life sciences industry (https://www.fieldfisher.com/en/sectors/life–sciences/life–sciences–law–blog/the–effect–of–a–pandemic–on–the–life–sciences–indu), [accessed 01.09.2020].
[95] *The future of virtual health. Executives see industrywide investments on the horizon*, Deloitte, 2020.

areas within the specialisation is also expected, which may boost the impact of the specialisation on the Małopolska Region economy.

DiagDiagnosis in the domain of Sustainable energy

Scope and general nature of the specialisation

IS Sustainable energy has been defined on the basis of six fields[96], which, in simple terms, serve to develop and implement innovative solutions related to 1) generation (including recovery and conversion), storage and transmission of energy, 2) intelligent, sustainable use of energy by its recipients (e.g. as a result of thermo–modernisation of buildings or prosumer energy development) and 3) creation of new equipment, consumption points, buildings (energy–efficient installations, buildings, cities, transport systems, etc.) enabling Sustainable energy use. This, basically, corresponds to the subject structure of the entities forming the specialisation, primarily related to: generation of electricity (PKD 35.11.Z), trade in electricity (35.14.Z), distribution of gaseous fuels in a network system (35.22.Z), generation and supply of steam, hot water and air for air conditioning systems (35.30.Z) or production of electricity distribution and control apparatus (27.12.Z), although such a list (as indicated by its authors themselves[97]) is definitely incomplete and requires additions. First of all, it is necessary to point to the chain (or network) of[98] entities related to energy–saving construction services and various profiles of related activities (e.g. energy consulting[99]) or the entities (including e.g. electronic, electrical engineering, automatic and IT companies) developing smart grid solutions.

The traditional "core" of specialisation, related to large entities generating and distributing electricity, heat or gas (belonging to section D of PKD) is not included, as opposed to processing industry, in statistical classifications in terms of B+R intensity. Nevertheless, taking into account the contemporary, growing technological advancement of entities providing energy, water, gas etc., the sector should be considered highly knowledge–intensive and even dependent on innovations in its development[100]. Therefore, it is not surprising that the sector is open to, inter alia, cooperation with technological start–ups[101] or other industries, e.g. space technologies[102].

A quite specific factor for the specialisation domain Sustainable energy is the fact of a clear territorial combination of business and social objectives. **The development of innovation and competitiveness of entities in this domain is connected not only with the sale of products and services to buyers, but with a broader objective of further transformation of the Małopolska Region into an energy–sustainable region**. This is related, among other things, to the implementation of the objectives of EU climate policy, but also to increasing the quality of life of the region's residents. This is of considerable importance from the point of view of the directions for specialisation development.

[96] Smart grids and energy storage, Clean fossil fuel treatment and conversion technologies, Energy efficiency, Energy from waste and chemical energy carriers, Renewable energy sources, Energy efficient smart buildings and cities (*Smart specialisations...*, op. cit.)
[97] *Charakterystyka dziedzin...*, op. cit., p. 27.
[98] *Sieci współpracy biznesu, nauki i samorządu w obszarach inteligentne sieci energetyczne, budownictwo energooszczędne, biotechnologia, medycyna translacyjna. Raport z badania prowadzonego w ramach projektu SPIN – Model transferu innowacji,* Centre for Evaluation and Analysis of Public Policies, Jagiellonian University, Kraków, 2013.
[99] Ibid, p. 54.
[100] Cf. *Innowacje dla energetyki. Kierunki rozwoju innowacji energetycznych,* Ministry of Energy, Warsaw 2017.
[101] *Startupy zredefiniują branżę energetyczną,* , (https://www.cire.pl/item,186737,8,0,0,0,0,0,startupy–zredefiniuja–branze–energetyczna.html), [accessed: 02.09.2020].
[102] *Energetyka napędzana przez innowacje,* , (https://www.kierunekenergetyka.pl/artykul,68837,energetyka–napedzana–przez–innowacje.html), [accessed: 02.09.2020].

Value chains from the perspective of the output of the RIS Working Groups

The six fields of the Sustainable energy domain mentioned are diverse in nature. Most of the fields are related to technologies primarily dedicated to the energy generation sector[103] (Smart grids and energy storage, Clean fossil fuel processing and conversion technologies, Energy from waste and Chemical energy carriers), which forms the first distinguishable value chain. The second is related to the use of renewable energy sources (OZE), and the products and services in this chain may branch out into different customer markets (business, individual, domestic and foreign). In view of this diversification, its further analysis, in particular in terms of current and future competitive potential, is a task for the stakeholders of the specialisation. The third chain concerns solutions related to energy–efficient buildings and cities. A horizontal field, running across the others, is the issue of energy efficiency. Although it does not directly result from the current document specifying the Małopolska Region IS (although it is present in other materials devoted to the domain), with each of the indicated value chains the issue of prosumer energy can be additionally connected (appearing directly in the fields of specialisation in the domains: Information and communication technologies and Electrical engineering and machine industry).

From the perspective of the recipients of the solutions developed within the domain, the energy generation and distribution sector should be distinguished, as well as the current (modernisations, process innovations, energy efficiency improvements) and future (new buildings, networks, installations), individual and collective energy consumers (including prosumers). However, **the nature of the value chains and cross–cutting issues related to Sustainable energy outlined above indicate the need to provide strategic activities for the domain in three main directions, complemented by horizontal issues of energy efficiency and prosumer energy**.

Value chains from the perspective of IS monitoring

16 of the 99 projects for which the Sustainable energy domain was indicated as the first assignment were simultaneously linked to another field within the domain. The most frequent parallel linkage was noted for the umbrella, general Energy efficiency, co–occurring primarily with Renewable energy sources and Energy–efficient smart buildings and cities. On the one hand, the slogan "energy efficiency" aptly and concisely encapsulates one of the objectives of "Sustainable energy" and thus has a communicative value that is important for encouraging action, e.g. competition activity, especially in an interdisciplinary perspective. On the other hand, effectiveness requires supporting terms to indicate who or what it concerns and how it is achieved. There **were also 43 cases identified – a relatively high share – where a project was simultaneously linked to a field from another domain**. Alliances with RIS3, RIS4 and RIS6 dominate, specifically with the fields that constitute the links in the construction services value chain: Smart design and Building management systems, Materials for construction and transport. The domain field that most frequently co–occurs in these links is Energy–efficient smart buildings and cities. As already mentioned before, these links are complemented by the issue of prosumer energy, found in RIS3 and RIS6. **Thus, the potential of RIS2 specialisation to integrate actors from different domains around their own value chains**

[103] Given the challenges of ensuring internal energy security (nationally and regionally), for simplicity we assume that this is mainly about power generation for the internal market.

can be seen. **The directions of regional innovation cooperation, organised e.g. through specialisation platforms, should take such links into account**.

Potential for specialisation in the light of monitoring and inclusion into GVCs

The field–based structure of the number of projects delineates three equidistant dimensions: two fields marked with strong development, two fields of average development and two fields with a minimum supply of well–developed projects. **The last category includes: Clean fossil fuel processing and conversion technologies as well as Energy from waste and chemical energy carriers (3.6 and 3.1% of assignments respectively)**. The field leader is the overall category Energy Efficiency (36.5%). The wide potential range of projects falling into this category undoubtedly supports this dominance. Although its horizontal character has already been mentioned, it is worth emphasising that also in terms of meaning, this field is inseparable from the others – e.g. it "absorbs" Renewable energy sources or Energy–efficient smart buildings and cities. The meaning coherence of the remaining field categories and the resulting depth of potential project intervention (the possibility of implementing a diverse range of projects within the field), should be considered as high.

The success rate does not vary significantly between the fields **and falls between 50 and 70%, with an average of 57%, 5 p.p. above the average for all domains combined**. **Hence, the entities within the Sustainable energy domain can be considered to be outstanding in terms of success in obtaining support**. The highest success rate, specific to the Clean fossil fuel processing and conversion technologies field, translates, in view of the low supply of applications, into only 7 projects.

Innovative potential and the scale of operations of the Małopolska region companies in the domain of Sustainable energy differs significantly, depending on the profile and size of the company. Certainly, we can talk about certain recognition of production and installation companies in the field of OZE (e.g. Vatra S.A., Eksploterm, Womar, Centrum Elektroniki Stosowanej Sp. z o.o, Senco or Geo–Term Polska S.A. listed on NewConnect), general building contractors and developers (e.g. Janex, Łęgprzem, Wawel Service) or – already more recognisable – manufacturers of materials and joinery for energy–saving building (e.g. Bruk–Bet, Austrotherm, Oknoplast, Fakro). In the field of OZE, developing companies from the photovoltaic sector, such as PV Energia, PV Instalator Polska Grupa PVGE Sp. z o.o., LMV Group Sp. z o.o. or Columbus Energy S.A. deserve special attention. An increase in demand for companies with a similar profile has been observed in recent years[104].

While, **outside the sector of large energy producers and suppliers**, **rather few large and medium–sized companies can afford to organise and run their own B+R departments** (e.g. manufacturers of building materials) and improve products to ensure a competitive position in GVCs, smaller players, especially those offering their services to individual investors (e.g. installation companies), operate in an increasingly competitive market with their offers of similar technological parameters. **This leads us to believe that the most important processes in their value chain will be those related to the acquisition of attractively priced technology (e.g. equipment such as heat pumps, photovoltaic panels), skilful marketing, sales and after–sales service**. An example is – also listed on NewConnect – Columbus Energy, which offers comprehensive, bundled investor service and a high availability of services, relying for the installations on technological solutions of, e.g., Chinese

[104] Cf. (https://www.polska2041.pl/energia/news–oze–rozruszaja–rynek–pracy,nId,3201275), [accessed: 22.09.2020].

producer Sunport Power (photovoltaic panels) or Swedish NIBE (heat pumps). Although this type of activity is not strictly associated with innovation on a global scale, the **development of the market in this direction and the orientation towards organisational and marketing innovations is conducive to the realisation of the social objective**, related to the growing awareness of society in the field of Sustainable energy, increasing demand for energy–efficient solutions and improving the energy profile of the region.

In a different situation are "**giants" such as the Tauron Group, which decisions and actions set the directions for the development of the sector and the search for innovation**. Tauron, which operates in southern Poland, including the Małopolska Region, has a portfolio of four directions of innovation development (Customer and their Needs, Intelligent Grid Services, Distributed Power Generation, Low Emission Generation Technologies) as part of its Strategic Research Agenda. The Group encourages the cooperation between start–ups by offering support for solutions with a technological readiness of at least TRL 7 (real–life prototype testing) within the accelerator. It consists in the possibility to test the solution under the guidance of dedicated experts using the infrastructure provided by the Tauron Group company[105]. It is also possible to obtain from 3 to 26 million PLN under programs financed by the investment fund CVC EEC Magenta, established by the Group in cooperation with the PFR and NCBR. One should also emphasize the high innovative activeness of the Tauron Group itself, which has obtained financing for 8 of its projects within the Power Sector Research Program (PBSE) implemented by the NCBR. **In 2025, the Group intends to obtain ¼ of its revenues from new business, including those arising from B+R works** – its own and those carried out with scientific and business partners[106]. A detailed analysis of the Tauron Group's "portfolios" of innovation development directions indicates their substantial convergence (sometimes even identity) with selected fields of smart specialisation. Therefore, **supporting the development (especially the early phase) of start–ups and other entities that fit into the strategic plans of the giant should become an effective direction of action for the region within RIS2**.

Provided it is developed, **academic entrepreneurship** can play an important role in seeking and offering innovative solutions, but also in stimulating demand for Sustainable energy and promoting services in this field. As far as the Sustainable energy domain is concerned, the **Małopolska Region has a very strong research and commercialisation potential provided by a number of scientific entities**, including e.g. the AGH UST Centre of Energy, two Małopolska Knowledge Transfer Centres – the Centre for Sustainable Development and Energy Conservation at the AGH in Miękinia and the Małopolska Energy–efficient Construction Centre at the Kraków University of Technology[107]. Moreover, AGH and UJ, together with other European universities, are partners of the EIT InnoEnergy company of the European Institute of Innovation and Technology[108], which provides opportunities for joint projects with European partners (including co–financing of research projects, support for start–ups, integration of education) in the field of energy. **The spin–off companies owned by AGH and related to the domain** ought to receive special attention At the moment, the University has in its portfolio

[105] (https://www.tauron.pl/tauron/tauron–innowacje/wspolpraca–ze–startupami/progres), [accessed: 02.09.2020]. In addition, the Tauron Group is involved in acceleration activities within the ScaleUP programme of the Kraków Technology Park and activities of this type can become a good practice replicated throughout the region.
[106] (https://www.tauron.pl/tauron/tauron–innowacje/projekty–badawczo–rozwojowe), [accessed: 02.09.2020].
[107] Knowledge Transfer Centres, established and developed under successive editions of the SPIN project, provide pro–innovative services to entrepreneurs (more than 300 have been supported so far) falling within different IS domains. More: (https://www.spin.malopolska.pl/), [accessed: 01.09.2020].
[108] A branch of Innoenergy Central Europe is located in Kraków, more at (https://www.innoenergy.com/), [accessed: 01.09.2020].

several such companies[109], e.g. Institute for Sustainable energy in Miękinia, Enetech, Gradis or already incubated JES Energia and NG Heat , with some **new ones being created**[110]**, which indicates the business innovative potential of the region within the domain which should be strengthened**. It is worth noting that for certain high–tech topics, such as fuel cells, outside of large energy companies, the only chance to take them on may lie in academic entrepreneurship[111]. An important resource strengthening the potential for cooperation, knowledge exchange and collaboration within the domain is the **South Poland Cleantech Cluster** (e.g. under the Małopolska Region RPO or the region's budget, the cluster organised workshops for start–ups), while at the junction of the domains (RIS2 and RIS3) the BIM cluster (Information Technology in Construction Services Cluster) operates.

Trends, niches and developments with the impact of the COVID–19 epidemic

Global demand for energy, including clean energy, will continue to rise. Hopes are high that over the next 20–30 years, new solutions will emerge to fully achieve or come close to climate neutrality. **The power sector also faces a number of smaller improvements and innovations related to the development of digital technologies**[112]. Artificial Intelligence and IoT can be used, for example, to minimise energy transmission losses. Cyber security of new equipment, installations and networks will also be of great importance. A steady **growth trend is forecast for OZE**, while key factors for the development of Sustainable energy, under the conditions similar to Poland, include **legal changes, standards and obligations** imposed by the state[113]. **As the example of the Małopolska Region anti–smog resolution shows, effective actions of this type can also be taken at the level of region's local government**. The fundamental importance of technological development and opportunities for the use of **distributed power engineering**[114] is also indicated. Power communities (power clusters, power cooperatives, etc.) play an important role in this case, as entities implementing OZE and modern energy management technologies, improving the stability of the power grid and supporting the fight against smog[115]. A serious challenge for OZE, but also for conventional power plants (due to the growing problem of drought), is the **risk of blackouts**[116]**, so solutions limiting the possibility of such situations will be desirable**. Due to the current low level of utilisation of such sources in Poland, an increase in the share of biomass[117] and low–temperature geothermics in energy generation[118] can be expected. Taking into account the above mentioned trends and forecasts, it should be acknowledged that the **specialisation domain is accurately and comprehensively tailored**, offering a chance to take advantage of the main opportunities within the environment.

[109] (http://www.innoagh.pl/portfel–spolek–spin–off/), [accessed: 02.09.2020].
[110] Established in 2020, but for the time being no further information is available.
[111] For the average domain company, this is a subject that is too advanced and distant in business terms, as was pointed out during the qualitative research of the specialisation representatives.
[112] *The Future of Energy*, Capgemini 2020, (https://www.capgemini.com/resources/the–future–of–energy/), [accessed 02.09.2020].
[113] (https://polskiprzemysl.com.pl/przemysl–energetyczny/przyszlosc–energetyki/), [accessed: 02.09.2020].
[114] (https://www.kierunekenergetyka.pl/artykul,63246,jak–bedzie–wygladala–przyszlosc–energetyki.html), [accessed: 02.09.2020].
[115] One example is the "Zielone Podhale" Energy Cluster, which was established in line with the initiative of AGH.
[116] (https://www.obserwatorfinansowy.pl/bez–kategorii/rotator/energetyczna–rewolucja–czekaja–nas–problemy–czy–swietlana–przyszlosc/), [accessed: 02.09.2020].
[117] (https://www.energetyka24.com/biomasa—wciaz–niewykorzystana–szansa–dla–polskiego–coalstate), [accessed: 02.09.2020].
[118] (https://www.abb–conversations.com/pl/2019/04/przyszlosc–energii–rozpoczyna–sie–transformacja–energetyczna/), [accessed: 02.09.2020].

As far as the domain–specific effects of the COVID–19 outbreak are concerned, it should first be noted that this does not generally translate into changes in the power sector's labour market, e.g. changes in working patterns, training or education needs or effects caused by a reduction in economic activity. On the other hand, **the second wave of the epidemic's impact, related to the problems of the sector's suppliers and customers, may be delayed**[119]. The epidemic may also translate into lower energy prices caused by a fall in electricity demand (lockdown of customer sectors) and a slight slowdown in the development of the OZE sector[120]. From an EU perspective, the power sector will be one of the key drivers of the recovery from the effects of COVID–19.[121]

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

The qualitative research with representatives of the specialisation[122] shows that a significant problem is mass import of relatively cheap products, especially from China, which may discourage the search for own innovative solutions. Growing interest of individual investors in OZE, with increased product availability and price competitiveness, on the one hand allows for more and more massive usage of Sustainable energy technologies but on the other hand **perpetuates the dominant pattern of imitative innovation**. Similar conclusions are reached by the authors of another report, which points out that an internal barrier to the development of specialisation is the attitude of **"following what happens on the market, without leaning out"**. Modernisation and process development are more important than expansion into other markets. External barriers characteristic for the domain also include **existing legal solutions which, to some extent, block the possibility for** businesses[123] to **operate**. The research also revealed the **expectation of stronger cooperation** with the local government administration (region, poviat (county)) in formulating action plans, communicating expectations and needs. The need to **modernise equipment and machine stock in relation to automation and digitisation of production** has also been reported. In addition to B+R activities in the domain, objectives beyond it, such as reduction of pollution, reduction of energy intensity, recycling, optimisation of production costs and automation, can also be achieved **through adaptation of good solutions implemented by other entrepreneurs,** which are often cheaper and have a potential for practical implementation "on the spot"[124]. However, this requires an effective incentive to share knowledge with others. An important role in this context may be played by clusters, in particular the South Poland Cleantech Cluster or the interdisciplinary BIM Cluster, which have already been mentioned earlier and are very active and related to the topic of Sustainable energy, although going beyond it as well.

[119] J. Wajer, *Wpływ COVID–19 na sektor elektroenergetyczny – czego powinniśmy się spodziewać?* (https://www.ey.com/pl_pl/covid–19/wplyw–covid–19–na–sektor–elektroenergetyczny), [accessed 01.09.2020].
[120] *Jak COVID wpłynął na branżę OZE?* (https://www.teraz–srodowisko.pl/aktualnosci/covid–19–oze–energia–odnawialna–8869.html), [accessed 01.09.2020].
[121] Konkluzje w sprawie reakcji na pandemię COVID–19 w sektorze energetycznym UE – droga do odbudowy – Konkluzje Rady (25 June 2020) (https://data.consilium.europa.eu/doc/document/ST–9133–2020–INIT/pl/pdf), [accessed: 01.09.2020].
[122] *Qualitative Jakościowe badanie małopolskich przedsiębiorstw działających w obrębie dziedzin wytyczonych przez inteligentną specjalizację regionu–edition 2019*, (https://www.malopolska.pl/_userfiles/uploads/Badanie%20firm%20IS%20–%20edycja%202019_1.pdf), [accessed: 08.09.2020].
[123] *Wyzwania i szanse rozwojowe małopolskich MŚP na rynku krajowym. Raport o przedsiębiorstwach z 7 regionalnych inteligentnych specjalizacji województwa małopolskiego*, Ośrodek THINK–TANK, Warsaw 2019, (https://contattafiles.s3.us–west–1.amazonaws.com/tnt38723/pjD13IJi2NVd2z9/Raport_Wyzwania–i–szanse–malopolskich–MŚP–na–rynku–krajowym.pdf), [accessed: 08.09.2020].
[124] *Qualitative study of the Małopolska Region enterprises...*– 2019 edition, op. cit., p. 26.

Diagnosis in the domain of Information and communication technologies

Scope and general nature of the specialisation

According to the RSI WM 2020, Information and communication technologies "refer to any activities involving the production and use of telecommunications and IT equipment and related services as well as collecting, processing, making information available in electronic form using digital techniques and all electronic communication tools. A special role in this field of key specialisation in the region is played by multimedia and creative sector companies[125], using Information and communication technologies.[126]. "Any" activities and tools suggest an **almost unlimited capacity of the domain**. This is confirmed by its detailing, consisting of 15 fields (the most out of all RIS). The specialisation is very broad, as its scope covers a wide variety of technologies and industries (e.g. sensors, multifunctional materials, robotics, information technology supporting quality production, etc.). Entities from the domain represent mainly section J of PKD – Information and communication activities[127]. Almost all divisions of this section (with the exception of division 60 – Public and subscription broadcasting) have been recommended for inclusion/retention within the smart specialisation area[128]. Most divisions of section J belong to high technology services and division 58 to other knowledge–based services. For the operations of entities in this type of business, **the key resources determining their position in value chains will therefore include an access to technology and its knowledge as well as human capital**. In the case of the operations of web portals, but also, more broadly, of entities processing data and offering services consisting in their specific processing and use, an important process and competitive resource is also **an access to information and data** – a source of supply for the sector. The development of information technologies constitutes the foundation for the growth not only of the ICT sector**,** but also of the entire economy and society. The competitiveness of Polish industries is largely based on the availability and quality of ICT sector solutions[129]. In the era of global changes **this is one of the key sectors for the future economic growth**.

Value chains from the perspective of the output of RIS Working Groups

As mentioned above, 15 technological fields were distinguished within the domain, which makes the Information and communication technologies IS the most extensive of all the Małopolska Region RIS. In a way, this is due to the specific nature of the domain – technological development is very dynamic, **the sector interacts with other branches of the economy** following trends, market demand and meeting customer expectations[130]*.* Although the description of ICT specialisation does not refer directly to the concept of value chains, it should be stressed that in the case of ICT sector entities, their technologies are used by global giants, domestic entrepreneurs and public administration. The wide range of clients shows that

[125] This means that the IS "Communication and Information Technologies" partly overlaps with the IS "Creative and Leisure Industries".
[126] *Charakterystyka dziedzin...*, Biostat, Rybnik, 2014.
[127] To a lesser extent, production of equipment – e.g. production of computers and peripheral equipment (PKD division 26), included in the domain as recently as 2014, was finally not included in the domain. ((*Charakterystyka dziedzin...*, Biostat), but there are, for example, machines and equipment automating and robotising processes or optical equipment.
[128] Cf. M., Mitka et al, op. cit.
[129] A good example of such an impact and global change for the sector brought by the implementation of ICT solutions is the preparation for large–scale implementation of the BIM methodology in the construction industry (Digitisation Strategy for the Construction Industry, cf. (https://www.gov.pl/web/rozwoj–praca–technologia/cyfryzacja–procesu–budowlanego–w–polsce—zakonczenie–projektu), [accessed: 16.12.2020].
[130] Cf. *Jakościowe badanie małopolskich przedsiębiorstw... – 2019 edition,* op. cit.

the implemented projects, products and services are developed in such a way as to be as complementary as possible to the market and to be used by various industries. **The horizontal nature of ICT** means that companies in this sector **can be present in many value chains of various industries**. A particular example are large enterprises, e.g. Comarch, providing its services to public administration, banking, accounting offices, cyber security, e–commerce, brokerage, electronic device manufacturers, FMCG, retail, transport and automotive, logistics, medical/healthcare or insurance industries[131]. Luxoft, on the other hand, provides its services to the automotive, media and entertainment, transportation, finance, telecommunications, energy, healthcare/Life science industries[132]. However, the fields of ICT domain were addressed primarily to the following sectors: medical/Life science (domains 3.1, 3.2), agro–food and forestry, including furniture (3.3, 3.4), energy (3.5), construction (3.6), transport (3.7), mining and resources (3.8), materials (3.9), creativity (3.15) and horizontally including sensors and technologies for data transfer and integration, networks, systems and the intercommunication of people and devices (3.10, 3.11, 3.14), automation and robotics (3.12, 3.13)[133]. Three issues seem to be the most important: 1) most of the distinguished **fields are connected with other fields and domains of the Małopolska Region IS**, which encourages the search for synergies between the entities (e.g. ICT – Life science, ICT – power industry, ICT – metal industry, electrical engineering and machine industry), 2) the most extensive descriptions are given of highly **horizontal areas related to data operations (e.g. smart grids and systems), which is a response to the main trends and technological challenges** in the sector, and finally 3) in part, the **details of the specialisations "overlap" with the descriptions of the remaining ones** (especially RIS 7), in a way that is not so much complementary, but rather duplicative. This requires adjustments leading to a better understanding of interdependencies between the domains of the Małopolska Region IS.

Value chains from an IS monitoring perspective

26 of the 178 projects for which the ICT domain was indicated as the first assignment were simultaneously linked to another field within the domain. The most frequent parallel linkage was noted between the fields previously classified as the so–called industry categories and two cross–cutting fields: Smart grids, systems integration and geo–information technologies as well as Process automation and robotics. There were also **21 cases of simultaneous linking of a project with a field from another domain, which is relatively small** considering the record number of assigned projects among the domains. This situation may be linked to the previously mentioned "arrangement" of most fields, which gives context to projects and makes links between the domains seem redundant. The most frequent links are **with the fields Process automation and robotics (RIS 6) and Graphic and industrial design** (RIS 7). Clear and conscious linkages between the ICT domain and other domains are important and desirable because, in contrast to some other domains and families of technologies (e.g. related to new materials, chemistry, nanotechnology, etc.), where concepts, molecules, etc. can be developed up to a certain point somewhat separately from the concrete application, in the case of ICT the **original orientation towards solving a concrete, practical problem or challenge** seems to be crucial. Hence, close cooperation with the customer, the business partner who is the recipient of the product/service, is a value in itself.

[131] (https://www.Comarch.pl/branze/), [accessed: 08.09.2020].
[132] (https://career.luxoft.com/), [accessed: 08.09.2020].
[133] Essentially, then, some fields can be classified as industry–specific and others as cross–cutting, technology–based.

Potential for specialisation in the light of monitoring and inclusion into GVCs

The field structure of the number of projects implemented under the RPO WM shows a **very high diversity**. 40% of the projects manage one field (Smart grids, Systems integration and Geo–information technologies)**, which, with 15 categories, means a very strong domination**. The second choice of project developers is Process automation and robotics (18%, which translates into 67 out of 377 realisations in the whole domain). At the same time, five or fewer assigned projects were identified for six fields, including one each for: Diagnostics and therapy of civilisation diseases and in Personalised medicine as well as in Optoelectronic systems and materials. The low number of projects may be related to the lack of disconnection with other domains – the already mentioned optic technology appears in an identically formulated field within RIS6, while the previously mentioned diagnostics is deeply categorised within RIS1. The semantic coherence of the domains is moderate. There is a clear division of the fields into two categories – the use of technology in specific industries, sectors of the economy and the development of tools or properties for cross–cutting applications. **The latter category concentrated 76% of the field assignments within the projects implemented**.

Leaving aside the fields represented by several projects (it is only worth noting that in the field of Diagnostics and therapy of civilisation diseases and Personalised medicine, only one of the eight proposals received support), **the success rate should not be considered as varying significantly.** For the four most prolific areas, it ranged between 43 and 52%. However, the rate for the *en bloc* domain is significant. **At 44%, it is clearly the lowest of all IS domains**.

In terms of the conditions for the development of specialisation, it must be emphasised that **the Małopolska Region is marked with a high concentration of ICT companies**. It ranks second among the regions with the highest employment rate in the ICT sector. Companies operating within this specialisation allocate high expenditures to B+R[134]. ICT companies from the Małopolska Region that conduct **active B+R** include: IT Vision, Clickmaster, Unima 2000, Bt Electronics, Polskie Karty, Archaman, Compedium–Centrum Edukacyjne, J–Labs, Enova, Hor.Net Polska, Adrem Software, IT PiAST, Elte GPS[135]. The region offers favourable conditions for the development of ICT specialisation in the form of: **intellectual capital potential (including relatively cheap labour force), laboratory and office facilities and an innovation support ecosystem**. Clusters are active, e.g. the Construction Information Technology Cluster (BIMklaster), the Digital Entertainment Cluster of the Małopolska Region or the IoT Cluster. Integration and networking activities are undertaken, among others, by KPT or the #OMGKRK Support Foundation. Entrepreneurs can also obtain support from Venture and Seed Capital funds based in the Małopolska Region[136]. The functioning of ICT companies is also supported by the infrastructure for the training of personnel[137] and a strong scientific base (universities), performing the functions of economically neutral centres of specialist knowledge.

Most of the companies within the ICT sector in the Małopolska Region are microenterprises, so they should be given separate attention, while the **presence of large enterprises,** such as

[134] Cf. *Wyzwania i szanse rozwojowe małopolskich MŚP...*, op. cit.
[135] Based on "Map of Brands – the Malopolska Region".
[136] M. Mitka and others, op. cit.
[137] Cf. M. Cholewa, T. Geodecki, J. Kulczycka, A. Nowaczek, Ł. Mamica, M. Możdżeń, M. Zawicki, *Oddziaływanie inteligentnych specjalizacji regionalnych na rozwój gospodarczy Małopolski,* Kraków 2016.

Akamai Technologies, International AG, Comarch, CD PROJEKT RED[138], Ericsson, ESET, IBM BTO Business Consulting Services, Luxoft, Ailleron, Motorola Solutions Poland, Nokia Networks Technology Center or Veracomp[139] should be pointed out as first. Most of these are subsidiaries of global companies, so their position within the GVC depends primarily on the position of the multinational corporation within the GVC. By far the largest ICT company in the Małopolska Region (in terms of employment) is Comarch[140], other large and important entities are Luxoft, Capgemini, Motorola. As far as smaller companies are concerned, in accordance with the specialisation assumptions, one can observe their **activity within many industries,** including[141]: business process management and rapid application programming, solutions for industry, banking and finance, security systems, database systems, mobile devices and applications, telecommunications, cloud solutions, education, video games, multimedia, the Internet of Things, smart cities and buildings, transport and logistics, health and telemedicine. Smaller players in the ICT sector are characterised as high growth companies (HGC), as exemplified by Miquido, which develops, among other things, mobile solutions. In 2016, it was ranked eighth in the 17th edition of the Ranking of Fastest Growing Companies in Central and Eastern Europe.

It should be noted that in the case of this domain, to a greater extent than in other IS, the position of enterprises (with domestic capital) in GVCs depends **not only on the quality of the product/service offered but, above all, on the position held by the business customer using these solutions**. This means that **marketing activities, acquisition of new customers become key elements** influencing the position of such enterprises in GVCs. In this context, special attention should be paid to the Małopolska Region's ICT start–ups. **Their importance in the mechanism of domain's inclusion into GVCs is growing**. The key ones include: 1000realities, 2040.ai, Airly, Brainly, Callpage, Codewise, Elmodis, Estimote, FindAir, HCM Deck, Husarion, Inmotion, Kontakt.io, Sales Manago, Seedia, Silvair, Synerise, Talent Alpha[142] . The position of start–ups in GVC depends on several factors. Firstly, the way the business is continued. If a company operates independently (develops its business), it has a direct or indirect impact on its position in the GVC. If it is acquired by a larger company, it becomes dependent on it. Secondly, the customer portfolio. A start–up may have a diverse catalogue of individual customers (B2C) or work for a large enterprise conglomerate (B2B). Thirdly, the scope of the business (it operates globally, in international markets, or locally, in the domestic market). Fourthly, the sources of funding. **Particularly important in the process of monitoring and inclusion into GVCs are start–ups from the deep tech category**[143]**,** as

[138] The CD PROJEKT Capital Group is headed by CD PROJEKT S.A., the holding company within which the development studio CD PROJEKT RED (https://www.cdprojekt.com/pl/grupa–kapitalowa/)operates, [access: 08.09.2020].

[139] Based on: *Sektor ITC w Małopolsce – New technologies, computer science, innovations;* (https://businessinmalopolska.pl/images/publikacje/opracowania/wydawnictwa_branzowe/Krakw_technologia_24122019.pdf), [accessed: 08.09.2020].

[140] Cf. *ICT sector in Kraków and Malopolska*.

[141] Based on a review of company profiles – the list would be long and still not exhaustive, hence we do not cite the names of specific companies.

[142] In the case of Brainly and Autenti, the former created an online platform for students and teachers, in which in 2019 as much as 30 million dollars were invested by, among others, the Naspers concern and Manta Ray (Sebastian Kulczyk's fund). The latter has developed a platform for digital contracting and electronic document circulation. A few days ago, PLN 17 million for this innovation was provided by Alior Bank, BNP Paribas and PKO Bank Polski, together with Innovation Nest and Black Pearls funds, cf. *Wydłuża się lista miast przyjaznych startupom* (https://regiony.rp.pl/trendy/23944–regiony–bogate–w–innowacje), [accessed: 08.09.2020].

[143]Start–ups from the deep tech group are those that not only use already existing technologies (e.g. APIs, software libraries), but also develop completely new, groundbreaking ones that did not exist before. For research purposes, we assumed that this category includes start–ups developing new technologies using machine learning, neural networks, blockchain or artificial intelligence (cf. *Polskie startupy – Report 2018 –* (https://www.citibank.pl/poland/kronenberg/polish/files/raport_startup_poland_2018.pdf), [accessed: 08.09.2020].

they stand the best chance of achieving a high position in Global value chains. Moreover, by offering the solutions in the digital space, they can increase turnover through product replication and service scaling as well as under favourable circumstances their capitalisation can grow faster than in other sectors of the economy. In the case of the ICT sector represented by start–ups from the Małopolska Region, this concerns the following technological areas: Internet of Things (e.g. AVSystem), Artificial Intelligence (e.g. Miquido), Virtual Reality (e.g. Duckie Deck), Robotics (e.g. Prodromus), Sensors (e.g. Silvair). Larger companies, including Comarch, among others, are also active in these areas. It is important to emphasise the very broad application of the said technologies in various fields, of which the Internet of Things is a particular example[144]. In the case of technological start–ups, their increased propensity for risk and orientation towards ambitious challenges provides a good platform for tightening and developing cooperation with universities. Due to the potential multiplicity of applications of the above mentioned technologies and the dynamics of the sector, in the next subsection we do not describe detailed technological trends, focusing instead on the influence of the COVID 19 epidemic on their formation.

Trends, niches and developments with the impact of the COVID–19 epidemic included[145]

Similarly to the Life science domain, the epidemic caused an increase in demand within the ICT industry (remote and mobile solutions)[146] – it was included into the industries identified as "the most resilient and **potential winners in the face of the epidemic situation**". The main success factors in this case are the increase in demand for remote solutions, the increased demand for data processing and the increase in demand for electronic entertainment[147]. The epidemiological situation has accelerated companies' use of digital platforms and investment in digital solutions, new hardware and software[148]. It has accelerated the **development of new customer service channels, in particular the e–commerce sector,** which is supported by a very high demand brought about by the quarantine conditions and the transfer of services to the Internet[149]. It is worth noting that online sales and customer service channels (e–commerce) **will be used by Polish enterprises also after the pandemic**[150]. Many of the processes involving the implementation of digital technologies, associated with the process of digitalisation, which were predicted to take place more gradually, have been accelerated. This concerns, inter alia, digitisation of city management processes in the area of smart city[151]. The

The Boston Consulting Group report *From tech to deep tech. Fostering collaboration between corporates and start–ups* (http://media–publications.bcg.com/from–tech–to–deep–tech.pdf) identifies the following technologies included in the so–called Deep–tech wave – Artificial Intelligence & data, IoT & sensors, Drones & robots, new materials & nanotech, Biotechnologies, Augmented/Virtual Reality, [accessed: 08.09.2020].

[144] Cf. IoT w Polskiej gospodarce. Raport grupy roboczej do spraw internetu rzeczy przy Ministerstwie Cyfryzacji.

[145] As regards the impact of the epidemiological situation on subsectors 3.1 (Medical engineering technologies, including medical biotechnologies) and 3.2 (Diagnosis and therapy of civilisation diseases and personalised medicine), they are described in the subsection Trends, niches and developments with the impact of the COVID–19 epidemic included related to IS Life science.

[146] *Gospodarka w czasach pandemii...*, op. cit.

[147] *Gospodarka w czasach pandemii...*, op. cit.

[148] See: (https://www.parp.gov.pl/storage/publications/pdf/08–COV–BPS–Survey_Poland_results_FINAL_PL_plus_author_info.pdf), [accessed: 08.09.2020].

[149] *Gospodarka w czasach pandemii...*, op. cit.

[150] K. Dębkowska, U. Kłosiewicz–Górecka, F. Leśniewicz, A. Szymańska, I. Święcicki, P. Ważniewski, K. Zybertowicz, *Nowoczesne technologie w przedsiębiorstwach przed, w trakcie i po pandemii COVID–19*, Polski Instytut Ekonomiczny, Warsaw 2020.

[151] *Covid–19 and the future of cities: 9 emerging trends in digital transformation* (https://www.citiestobe.com/digital–transformation–covid–19–future–of–cities/), [accessed: 08.09.2020].

acceleration also included the (already dynamic) **development of innovative educational services** (the so–called EdTech industry)[152].

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

Companies from the domain are aware of the significance of the influence from the EU funds on their business profile and appreciate their availability, both, in the case of B+R projects and projects enabling participation in international fairs. Nevertheless, the research subjects pay attention to the operation of institutional support, **negatively assessing the procedures and guidelines related to the implementation of the projects co–financed under the IS**. Apart from bureaucracy, the lack of precise, accurate and unambiguous guidelines, they also complain about the requirement to use the Competitiveness Database[153] and the selection of bidders in accordance with these guidelines. In innovative services, non–price criteria are very important success factors, such as competences and experience of the contractor, creativity and non–standard approach to the subject, experience in previous cooperation, trust (especially in the issue of know–how transfer by companies) or uniqueness of the service provision[154].

Entrepreneurs from the domain, surveyed as part of the qualitative monitoring, have **negative experiences in terms of the cooperation with universities**. They indicate, among others, that universities overestimate the costs of their work when the project is implemented with European funds. They emphasize that prices and work of market entities tend to be much more effective and attractive for them, and the very condition of cooperation with universities within B+R projects results in discouraging the surveyed from using the EU funds. The companies already having experience in such a cooperation, where costs exceed profits, prefer to implement activities from their own resources, as it is a faster and more effective way for them under the market conditions[155]. On the other hand, companies constantly emphasise the **financial barriers which they are unable to cross when they desire to implement large projects**. A way out may be to make the criteria regarding financial aid for the development of B+R activities more flexible, especially in terms of simplification of applications for the undertakings of a smaller scale (such as e.g. small Voucher for innovations), or the possibility of using B+R services with other companies[156]. Information needs were also indicated in terms of an access to financing and the manner of preparing applications, in particular, the **integration of information** to be in one place[157].

[152] See *Koronawirus a gospodarka – które branże zyskują na pandemii?* (https://startup.pfr.pl/pl/aktualnosci/koronawirus–gospodarka–ktore–branze–zyskuja–na–pandemii/), [accessed: 08.09.2020].
[153] A database of offers in which beneficiaries of European funds are obliged to publish, complying with the so–called principle of competitiveness. The principle of competitiveness applies to beneficiaries using the European Regional Development Fund, the European Social Fund and the Cohesion Fund, and is regulated at the level of guidelines on the eligibility of expenditure.
[154] *Jakościowe badanie małopolskich przedsiębiorstw... – 2019 edition*, op. cit.
[155] A solution to the excessively high costs of scientific entities' participation in grants may be to allow universities (with similar rights to scientific institutes) to be represented by their special purpose vehicles.
[156] Ibid.
[157] The already mentioned SPIN project, which is also implemented in other domains, helps to eliminate some of the barriers to the cooperation between the scientific community and entrepreneurs.

Diagnosis in the domain of Chemistry

Scope and general nature of the specialisation

The domain of IS Chemistry consists of nine fairly extensive fields[158] (which ranks it as one of the more diversified and broad in the scope regional IS) with a moderate degree of detail. They mostly refer to economic sectors which remain the recipients of products from the chemical sector. This applies to the following industries/sectors: healthcare (medicinal products), cosmetics/dermatology, agri–food, wood as well as pulp and paper, power (including alternative energy sources), mining, waste management, recovery technologies, recycling, construction and transport. This means that **value chains are located in at least one of the above mentioned nine sectors, in addition to the chemistry sector**. "Chemistry" is characterised by a strong and fairly stable position in the Małopolska Region in all indices related to the number of enterprises, wages and employment. However, in recent years the values of these indices have been decreasing in relation to analogous national data, which shows a decrease in the dynamics of the Małopolska Region chemical industry in comparison to Poland. Diagnosis of this type refers to three divisions of PKD section C: division 20 – production of chemicals and chemical products, division 21 – production of basic pharmaceutical substances and drugs as well as other pharmaceutical products, division 22 – production of rubber and plastic products, and division 38 of section E – activities related to collection, processing and disposal of waste, recovery of raw materials[159]. However, a significant part of the chemical sector in the Małopolska Region is classified as high technology (PKD 21) and medium–high technology (PKD 20)[160]. The characteristic conditions of the entities from the domain include a **significant degree of regulation (in particular from the EU perspective) within the sector** (including regulations related to standards, norms in the field of environmental protection), significantly influencing its functioning[161].

Value chains from the perspective of the output of the RIS Working Groups

The clarification of specialisations made by the WG indicates the need to go beyond a narrow understanding of the chemical sector and to focus on the value chains associated with the nine areas of specialisation mentioned. Such ones are cross–sectoral, e.g. Chemistry in healthcare, Chemistry in agriculture and agro–food, wood and pulp and paper industry or Chemistry in energy or technological, e.g. Advanced materials and technologies, Sensors. Extensive fields defining other areas of application of Chemistry are also indicated (Natural resources, Waste management), but the detailing of these fields does not, in every case, clarify the place of Chemistry in imaginable value chains. This demonstrates the **high level of "horizontality" of specialisation** and is a result, inter alia, of the fact that the chemical industry is closely related to other sectors of the economy and is **one of the largest and most diverse industries in the world**[162]. This is also confirmed by qualitative research with Małopolska entrepreneurs, who indicate that they have problems with the classification of some of their current ideas, for, on the one hand, they touch several fields and, on the other hand, it happens that they do not

[158] Chemistry in healthcare, Chemistry in agriculture and agro food, wood and pulp and paper industry, Biological and environmental chemistry, Chemistry in power industry, Natural resources, Waste management, Materials for construction and transport, Advanced materials and nanotechnologies, Sensors.
[159] Mitka M. et al, op. cit., p. 176.
[160] *Nauka i technika w 2018 r.. ,* op. cit., p.202.
[161] *Jakościowe badanie małopolskich przedsiębiorstw... – 2019 edition*, op .cit.
[162] *Press release*, BASF, 2017.

fit into the specialisation[163]. This leads to treating chemistry primarily in horizontal terms, strengthening value chains in various sectors (**while recognising the specific nature of the niche related primarily to the cosmetics and pharmaceutical industries**)[164].

The analysis of the detailing level with regards to smart specialisations leads to the conclusion that the Chemistry domain **is associated (to a greater or lesser extent) with as many as five other IS in Małopolska**[165]: Life science (Medicinal products and medical devices, Healthy food and nutrition), Sustainable energy (Clean fossil fuel processing and conversion technologies, Energy from waste and chemical energy carriers, Renewable energy sources), Information and communication technologies (Environmentally friendly transport solutions, Sensors (including biosensors) and smart sensor networks), Production of metals, metal products and non–metallic mineral products (Innovative pro–ecological technologies of waste reduction and management, Innovative technologies and industrial processes), Electrical engineering and machine industry (Process automation and robotics). These, in turn, overlap with one other in some of the fields mentioned.

Value chains from the perspective of IS monitoring

18 of the 137 projects for which the Chemistry domain was indicated as the first assignment were simultaneously linked to another fields within the domain. The most frequent concurrent linkage was recorded for the field Biological and Environmental Chemistry, co–occurring with Advanced Materials and Nanotechnologies. There were also 32 cases of simultaneous linking of a project with a field from another domain. The predominant linkages are with RIS 5, RIS 7, specifically with the cross–cutting field referred to as Innovative industrial technologies and processes as well as with Graphic design and industrial design.

Potential for specialisation in the light of monitoring and inclusion into GVCs

The structure of the number of projects carried out within the nine domains of the specialisation is heterogeneous. Two fields are more than twice as successful as the average within the domain, and symbolic numbers (1–4) of assigned projects are recorded for three fields. The four remaining domains oscillate around averages. The **dominant categories are Chemistry in agriculture and agri–food, Wood as well as pulp and paper as well as Materials for construction and transport** – 22% and 25% of assignments respectively. Areas with single realisations are Chemistry in energy, Natural resources and Sensors. All three are defined broadly, although limited in scope[166] by small numbers of technological detailing at a lower level. The small number of projects may also be related, in the case of the first two, to their inclusion into the Sustainable energy domain and, in the case of the third, into the Electrical engineering and machine industry domain, where Chemical sensors are explicitly mentioned. This lack of separation is also evident for the field Waste management, which has its counterpart in RIS 2, in the form of the fields including Energy from waste and Chemical Energy

[163] *Jakościowe badanie małopolskich przedsiębiorstw... – 2019 edition*, op. cit.
[164] For example, PKN ORLEN is committed to developing its production assets in southern Poland. Hence the decision to build a propylene glycol unit, which will enable further use of the glycerine produced. Glycol is a product commonly used in cosmetics, among other things. The production capacity of the planned installation will amount to approx. 30,000 tonnes a year, i.e. production at the Trzebinia refinery will be able to cover as much as 75% of demand for this product in Poland. ORLEN Południe will thus become the first glycol producer in Poland. Capital expenditure in this respect is estimated at over PLN 200m. (https://polskiprzemysl.com.pl/przemysl–chemiczny/inwestycje–w–orlen–poludnie/), [Access: 22.09.2020].
[165] Nevertheless, as can be seen a little further on from the monitoring data, RIS4 is also sometimes associated with part of RIS7, meaning that "chemistry is everywhere".
[166] Although the fields are potentially capacious, the third level of specialisation detailing indicates only a slice of this potential scope in which the intervention is to be delivered.

Carriers. This overlap does not result in the lack of projects, but it is possible that some of them are implemented under a different banner. At the same time, the meaningful cohesion of the fields within the domain itself should be regarded as limited. It is true that most of the categories direct the projects towards the areas of application (e.g. Chemistry in agriculture..., Chemistry in health care), but they are complemented by the fields described by the order of raw materials (Materials for construction and transport) or final products (Sensors).

The success rate clearly differentiates the fields. Without taking into account the categories in which individual projects have been implemented, applications from the Waste management field are the least successful (36%), and those from the Chemistry in agriculture and agri–food, Wood as well as pulp and paper industries are the most successful ones (69%). Given the large number of projects progressing to the implementation phase in the case of the latter domain, **it is worth discussing with domain representatives the relationship of the domain to value chains from other domains (mainly Life science) in terms of achieving synergies**.

Due to the aforementioned broadness and horizontality of specialisation, it is difficult to identify a clear, unambiguous profile of entities forming the specialisation or to indicate its distinguishing feature. However, it is certainly worth noting a few properties.

The first of these is the **presence in the region of large private entities as well as state–owned companies and foreign corporations**[167], involved in various levels of GVCs. The most important include St. Gobain, Air Liquide, Braxair, Lurgi, Grupa Azoty, Synthos, S.A., Rafineria Trzebinia S.A (Orlen Południe); Alventa S.A., Dragon Poland Sp. z o.o. Sp.k., BP Europa SE Branch in Poland, Krakchemia S.A., Linde Gaz Polska Sp. z o.o., Novatek Polska Sp. z o.o., Orlen Oil Sp. z o.o., Slovnaft Polska S.A., Solvent Wistol S.A., Cortex Chemicals[168]. Some of these entities (and additional ones) also belong to the Polish Chamber of Chemical Industry[169]. They produce for[170]: healthcare (medicinal products, e.g. Air Liquide Global E&C Solutions Poland S.A.), cosmetics industry (e.g. Smart Nanotechnologies, Alventa S.A[171], Orlen Południe), agricultural and food industry (e.g. Air Liquide Global E&C Solutions Poland S.A, Alventa S.A, Orlen Południe, WOFIL, Grupa Azoty), wood as well as pulp and paper industry; e.g. SYNTHOS S.A, power industry (including alternative energy sources, e.g. EBA, Linde Gaz Polska Sp. z o.o.), mining industry, waste management, recycling (e.g. SYNTHOS S.A, Linde Gaz Polska Sp. z o.o.), construction (e.g. Consil, Air Liquide Global E&C Solutions Poland S.A, Smart Nanotechnologies, Dragon Poland, SYNTHOS S.A.) or transport (e.g. EBA, Dragon Poland, Chemmot, Air Liquide Global E&C Solutions Poland S.A). From the regional perspective, including PPO, the fact that **chemical companies are "multi–industry" means that they can feed multiple value chains and explore new, potential smart specialisations**. Nevertheless, the presence of foreign capital in the sector (Air Liquide Global

[167] The value of BIZ under PKD 20 (Production of chemicals and chemical products – investment value (USD million) between 1989 and *2017* was 1,041.00 (see: *Inwestorzy zagraniczni w Małopolsce w 2017 roku*, Małopolskie Obserwatorium Rozwoju Regionalnego, Department of Regional Policy, Kraków 2019.

[168] *Przewodnik. Małopolskie Inteligentne Specjalizacje* (https://www.malopolska.pl/biznes/innowacje/inteligentne–specjalizacje–regionu), [accessed: 01.09.2020].

[169] See (https://www.pipc.org.pl/czlonkowie), [accessed: 01.09.2020].

[170] The summary was compiled on the basis of: a) Map of brands – the Malopolska Region (https://www.mapa–marek.pl), [accessed: 01.09.2020], b) list of the Malopolska Region members of the Polish Chamber of Chemical Industry (https://www.pipc.org.pl/czlonkowie), [accessed: 01.09.2020]. c) the study of the Business in Małopolska Centre – the Małopolska Region Economy of 2017.

[171] By 2018 Alwernia; (http://www.alwernia.com.pl/), [accessed: 01.09.2020].

E&C Solutions Poland S.A[172], Polynt Composites Poland Sp. z o.o.[173], Linde Gaz Polska Sp. z o.o[174]) makes it necessary to look at the specialisation also from the GVC perspective. Building a high position within GVC is done primarily **by selling products to foreign customers/entities.** Examples include: Smart Nanotechnologies (a subsidiary of Alventa S.A.), Dragon Poland, Consil, EBA, SYNTHOS S.A., Linde Gaz Polska Sp. z o. o. Moreover, the company's strong position in GVC is also guaranteed by its **dominant position in the production of selected chemical products**, e.g:

a) SYNTHOS – The Synthetic Rubber segment is the Group's core business. Approximately 80% of the sales volume of the Group's products in this segment is consumed by the major players in the tyre market, including Michelin, Continental, Bridgestone, Goodyear and Pirelli. Other markets, including manufacturers of technical rubber products, shoe soles, hoses and transmission belts, account for the remaining 20% of sales volume in this segment,
b) Grupa Azoty – the largest Polish and second largest European Union producer of nitrogen and multi–component fertilizers, currently implementing one of the key investments in the history of the Polish chemical industry[175],
c) Air Liquide Polska Healthcare – the world leader in medical gases.

The second important characteristic is to **have in the company's portfolio products characterised by at least a medium technological level**, including the so–called dedicated – specialised products). Examples are: Smart Nanotechnologies (products in the area of nanotechnology), Naftochem (specialised lubricants), Air Liquide Global E&C Solutions Poland S.A (medical gases), SYNTHOS S.A. (construction chemicals), Linde Gaz Polska Sp. z o.o (medical gases, industrial gases). The third characteristic is the **possession of certificates guaranteeing the high quality of products, e.g. ISO, etc. and emphasising the ecological dimension of the offered products**. NAFTOCHEM, Gold Drop, EBA, Alventa S.A, SYNTHOS S.A. or Fagumit are leading in this respect.

Another feature which, however, is related to the aforementioned inclusion of the sector into high or medium–high technology industries, is **conducting B+R activities (in particular, using specialised organisational units within the enterprise)**[176] e.g. Smart Nanotechnologies, Naftochem, Dragon Poland, Nycz Interrade, EBA, Alventa S.A, SYNTHOS S.A., Grupa Azoty.

In conclusion, from the perspective of the value chains, the picture of the Malopolska Region Chemistry domain is indeed and potentially complex, which calls for in–depth reflection and discussion on the scope of activities particularly appropriate from the regional level.

Trends, niches and developments with the impact of the COVID–19 epidemic

Since nearly 70% of the chemical sector's sales are made to other sectors/branches of the economy, e.g. construction, automotive, furniture, food, pharmaceuticals, textiles, electronics,

[172] The company operates in over 80 countries; (https://www.airliquide.com/group), [accessed: 01.09.2020].
[173] The company operates in dozens of countries on 3 continents; (https://www.polynt.com/info–di–contatto/polynt–nel–mondo/), [accessed: 01.09.2020].
[174] The company operates in dozens of countries (https://www.linde–worldwide.com/en/index.html), [accessed: 01.09.2020].
[175] (https://pkch.grupaazoty.com/aktualnosci/grupa–azoty–w–elitarnym–gronie–firm–najwazniejszych–dla–polski/l), [accessed: 04.09.2020]. The second most important segment in Grupa Azoty is the plastics segment. Two companies within the Group manufacture: in Tarnów and Guben (Germany). Grupa Azoty's main products within plastics are Tarnamid and Tarnoform.
[176] Companies from the chemical industry also use human resources from external entities. An example is e.g. Orlen Południe as part of projects from POIR funds (https://www.orlenpoludnie.pl/PL/OFirmie/Strony/Dotacje–INNOCHEM.aspx), [accessed 01.09.2020], or Consil (cooperation with the Jagiellonian University, the Academy of Fine Arts in Kraków or the Laboratory Research Department).

agricultural production and plastics, the chemical sector is strongly affected by the situation in other sectors of the economy. It is therefore **vulnerable to unfavourable economic fluctuations**[177] (in the case of COVID–19 this is particularly true for the automotive, transport, textiles[178] sectors; an exception are chemical products used primarily by the pharmaceutical sector, which has been developing steadily in recent years and for which the epidemiological situation is proving to be an additional catalyst for development and then the cosmetics sector). Impaired access to raw materials due to an epidemic situation leads to dysfunctional supply chains[179]. An epidemic may result in a **decline in chemical production,** and possibly**:** reduced production volumes, reduced orders and investment[180]. However, at the moment, the global crisis is also **an opportunity for the development of the industry**[181] due to a more difficult situation of the chemical sector companies in other markets, where the epidemiological situation is less favourable than in Poland. It will be important **to take into account within the IS the forecast trends in the chemical industry**, including, in particular, the progressive robotisation, spatial printing, industrial automation, smart applications[182], logistic innovation and digitalisation (Chemistry 4.0)[183]. Additional trends that will influence the development direction of the sector are: lightweight vehicles and electric cars, medical genome editing, plant genome editing, personalised medicine, industrial biotechnology and digitisation of agriculture[184].

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

In the aforementioned survey among IS stakeholders[185], they paid particular attention to the need for further support for the sector in terms of B+R works and the necessity to implement environmental solutions in enterprises (within the framework of challenges related to the **European Green Deal** and adaptation of companies to solutions postulated within such one[186]). The representatives of companies indicate that most enterprises operate in the reality of strong competition, where taking care of securities, meeting requirements, obtaining subsequent certificates or implementing standards is a regular course of action. They are aware that such activity, apart from the implementation of innovations and B+R works, is their ally, as it indicates constant development and care for the quality and comfort of customers or suppliers[187.] As regards B+R, difficulties in cooperation between entrepreneurs and universities were indicated and it should be noted that not in every IS domain such problems occur with equal intensity. Potential applicants clearly **need a new formula for defining themselves in relation to smart specialisation**. This is because they have difficulties in assigning IS by project applicants. Although the participants of the qualitative research postulated additional detailing of IS, it should be evaluated as the wrong direction, because IS in the Małopolska

[177] *Postulaty przemysłu chemicznego ws. Kryzysu wywołanego pandemią COVID–19.*
[178] *Gospodarka w czasach pandemii...,* op. cit.
[179] For example, Grupa Azoty has also identified the first cases of limitations on its ability to supply oxo alcohols and plasticisers to markets in countries at high risk of epidemics due to both production limitations of its contractors and transport restrictions. Markets particularly threatened by pandemics receive approx. 25% of the volume of oxo alcohols and plasticisers is directed to markets at high pandemic risk, see: (https://www.chemiaibiznes.com.pl/aktualnosc/koronawirus–zaatakowal–polska–chemie/3), [accessed: 01.09.2020].
[180] *Postulaty przemysłu chemicznego ws. Kryzysu wywołanego pandemią COVID–19.*
[181] (https://www.stockwatch.pl/wiadomosci/5–gieldowych–branz–zarazonych–koronabessa,akcje,256381), [accessed: 01.09.2020].
[182] (https://polskiprzemysl.com.pl/przemysl–chemiczny/trendy–w–przemysle–chemicznym/), [accessed: 01.09.2020].
[183] (https://www.kongrespolskachemia.pl/), [accessed: 01.09.2020].
[184] Deloitte, *Chemistry 4.0 Growth through innovation in a transforming world*, 2018 (https://www2.deloitte.com/pl/pl/pages/energy–and–resources/articles/Raport–Chemistry–4–0.html), [accessed: 01.09.2020].
[185] *Jakościowe badanie małopolskich przedsiębiorstw – 2019 edition*, op. cit.
[186] See (https://www.kongrespolskachemia.pl/), [accessed: 01.09.2020].
[187] *Jakościowe badanie małopolskich przedsiębiorstw...* – 2019 edition, op. cit.

Region are among the most developed ones (compared to other regions in Poland) – the **approach based on justifying the entry of projects into the value chain within or between domains, as postulated in the document, may prove to be a solution.**

Diagnosis in the domain of Production of metals, metal products and non–metallic mineral products

Scope and general nature of the specialisation

IS Manufacturing of metals, metal products and non–metallic mineral products is seemingly the most homogenous industry specialisation of the region, constructed around branches of metallurgical and mineral industries – obtaining and processing of proper raw materials, production processes, technologies applied in them. **However, it shows a great potential for serving an exceptionally wide range of sectors for which its universal products and their properties are indispensable, which encourages to perceive it as a horizontal domain.** It encompasses scientific disciplines such as materials engineering, ceramics, geology, geophysics and geochemistry. In the light of the verification data[188], the specialisation is distinguished in the region by high readings of general economic indicators (especially exports and the value added stimulated by them) and a high share of innovative projects in the received support from EU structural funds.

Three divisions of PKD (23–25[189]) belonging to the section of industrial processing are consistently and unanimously[190] associated with specialisation, which facilitates obtaining and analysing data mediated by this classification. **None of the divisions are classified as high or medium–high technology industries, which confirms the inter–subjective perception of the industry as predominantly traditional**. On the other hand, the equally traditional divisions of PKD (07, 08 and 09) covering mining of metal ores, other mining and auxiliary service activities are not included in the specialisation, despite the fact that they undoubtedly involve supply processes which are links in the value chain of many industry entities. The domain is – separately from the others – covered by three sections (XIII–XV[191]) of the CN nomenclature, i.e. the classification of goods in international trade. Taking into account the raw material dimension allows it to be extended by section V, i.e. mineral products. The development of the specialisation, represented in the region by almost 7000 active entities[192], is based on strong processors of raw materials (ArcelorMittal Poland) and manufacturers of semi–finished and finished products (e.g. Stalprodukt, CANPACK), around which a number of subsidiary companies operate. **The key activities and processes determining the generation of value and the position of entities from the specialisation Production of metals... in value chains are therefore primarily associated with logistics processes in procurement, operations and infrastructure.**

Value chains from the perspective of the output of the RIS Working Groups

The determination of the specialisation scope, carried out by the WG on the specialisation Production of metals,..., perpetuates the industry homogeneity of the domain, reducing it to

[188] Cf. M. Mitka et al, op. cit.
[189] Accordingly: PRODUCTION OF OTHER NON–METALLIC MINERAL PRODUCTS; PRODUCTION OF BASIC METALS; PRODUCTION OF FABRICATED METAL PRODUCTS, EXCEPT MACHINES AND EQUIPMENT.
[190] A number of analyses available on the UMWM website: (https://www.malopolska.pl/biznes/innowacje/badania–i–analizy), [accessed: 04.01.2021].
[191] Accordingly: ARTICLES OF STONE, PLASTER, CEMENT, ASBESTOS, MICA OR SIMILAR MATERIALS; CERAMIC PRODUCTS; GLASS AND GLASSWARE; NATURAL OR CULTURED PEARLS, PRECIOUS OR SEMI–PRECIOUS STONES, PRECIOUS METALS, METALS CLAD WITH PRECIOUS METAL AND ARTICLES THEREOF; IMITATION JEWELLERY; COINS; BASE METALS AND ARTICLES OF BASE METAL.
[192] T. Kwiatkowski, *Małopolskie inteligentne specjalizacje. Kompleksowy przegląd danych monitoringowych*, Kraków: UMWM, 2019.

four, disjoint (although not exhaustive) from the point of view of the industry cycle, fields (Sourcing and processing, Structures and components, Performance characteristics, Waste management)[193] and one "umbrella", general field: Innovative industrial technologies and processes[194]. The latter has the **potential to concentrate activities and projects specific to the different stages of the cycle but also projects that do not fit into these stages, remain at their interface or are, at the same time, relevant to the fields designated in the other domains.** The domain that naturally complements and develops the value chains of the metal industries is Electrical engineering and machine industry. It intertwines primarily in the procurement and after–sales processes but also stimulates technological development. After all, innovative metal products are the basic supply product for the transport industries (demand from the automotive industry is generated not only regionally but also – owing to proximity and spatial accessibility – by two regions where it is strongly clustered and inscribed in the smart specialisation: Śląskie and Podkarpackie Regions) and machine industry (for energy or construction applications). Other overlapping fields, which – referring to the structure of the Małopolska region's smart specialisation – lie within a completely different set, may contribute to strengthening the domain's value chains. Design will undoubtedly be valuable for the process of Marketing and sales (7.2 domain), while the process of Technology development may draw on achievements, e.g. in the field of Materials and composites with advanced properties (3.9 domain) or Waste management (2.4 and 4.6 domains). **The previously mentioned universality of products (understood in terms of their basic, raw material properties) makes, however, the chains of this specialisation permeate through almost the entire economy, being able to enter into value–creating configurations with a wide range of sectors/industries/branches.**

Removing the nimbus of "tradition" from the specialisation and encasing it with the connotations of "smartness" by WR is achieved through clear means of expression, which boils down to consistent characterisation of fields in the category of "research and development", suggesting that the expected projects and undertakings realised under the banner of the domain ought to be 1) based on scientific knowledge and 2) provide innovative solutions. Enforcement of such standards is facilitated by detailing the fields (description of specialisation at level III) to 48 technological categories, described, relatively consistently, with adjectives: innovative, advanced. As a result, innovative **niches crystallize at the junction of the traditional, strongly commodity–oriented industry and other highly specialised industries** (for the domain in question, this may be e.g. stainless acid–resistant steel for the use in the food industry).

The fact **that WG singled out the field of Raw materials processing, taking into account their location, enrichment and extraction, shows how important – from the perspective of value chains of entities specialising in this area – the links of logistics processes in supplying are**. The separation of the "Raw material" field contrasts with the omission of its relevant areas of analysis in monitoring identified above. The tasks of identifying and interweaving of raw material entities into the chain of the domain, which will enable monitoring, will be realised in the form of the so–called specialisation platforms, if the planned piloting of the new way of organising PPO in the region proves such validity.

[193] The domains are arranged in the logical order of the potential cycle. The order is not the same as the order proposed by the WG.
[194] *Inteligentne specjalizacje województwa małopolskiego,* op. cit.

Value chains from the perspective of IS monitoring

21 out of 107 projects for which any of the fields of the domain Production of metals... was indicated by RPO beneficiaries (as of 1 July 2020) as the first assignment, were simultaneously linked to another field within the domain. The most frequent parallel links were recorded for the domains Innovative, pro–ecological structural solutions and components in machines, equipment and means of transport and Innovative technologies and industrial processes. The latter, almost as often, was associated with the domain Innovative, pro–ecological technologies of waste reduction and management. **There were also 15 cases of simultaneous linking of a project with a field from another domain.** Most often these are interdisciplinary connections to RIS 6 and RIS 7, specifically to the fields Sustainable energy, Smart and energy–efficient construction (domain 6.3) and Graphic and industrial design (domain 7.2). This information, together with the above–mentioned observations, may be a hint for, e.g. profiling competitions within the RPO, but also for selecting potential subjects or partnership proposals within the planned formula of the PPO (specialisation platforms).

The dominance of the field Innovative technologies and industrial processes in terms of the projects assigned from the RPO (3/5 of all the projects assigned within the domain) **is undoubtedly a consequence of its broad formulation, enabling the management of practically any project included in the sectoral code of the domain**. This means, at the same time, powering potentially many processes that make up the delivered value expressed in the competitive advantage. Other fields, on the other hand, are clearly narrowed down to aspects of raw materials, material properties or application industries and, as shown earlier, are disjointed as stages in the industry cycle. It is noteworthy that the domain is categorised into a total of 5 fields, which is relatively few compared to most IS (e.g. 15 fields were identified for ICT). However, this ordering can be interpreted more as a broadening of the field scope, rather than a narrowing of the possible project activity within the whole domain. This is indicated by the relatively high number of categories of the third level of detail, clearly exceeding the numbers observed in the case of several domains with relatively more fields (second level of detail).

Potential for specialisation in the light of monitoring and inclusion in GVCs

The field structure of the number of projects submitted to the RPO shows a clear dominance of the Innovative technologies and industrial processes field. The next one – Innovative pro–ecological structural solutions and components in machines, equipment and means – managed over 23% of assignments within the domain. The fewest projects were implemented in the field of Raw materials extraction and processing (2% of all within the domain). **This distribution of projects is largely a consequence of the meaning heterogeneity of the fields. As shown, the dominant field is umbrella–shaped, horizontal and** – as a complementary heading under which projects are implemented – **has the potential to combine with others.**

The model starting point for the value chain domain is the provider of the technologies, which are applicable to raw material extraction on the one hand and manufacturing on the other. If the extraction stage is omitted and the raw material supplier is sourced, the manufacturer focuses on manufacturing technologies. The intermediate product manufactured is delivered to an exchange or an intermediary (naturally, this link can be omitted (by–pass)). The next link is sales and distribution to industrial customers and then, after shaping into a final product, to

final consumers – individual or corporate[195]. Marketing processes and after–sales service also accumulate at this last stage. **The relative stability of the metal and mineral industries is guaranteed by the demand from the "eternal" – in terms of a long–term perspective – sectors: automotive, construction, aviation, energy or broadly defined machine industry,** but also the packaging industry, the production of which is driven by the average life span limited to one year[196].

In regional terms, the domain is based on strong players, both on the side of processors of raw materials and producers of medium and highly processed products for the industry and individual customers. The emblem of the Małopolska Region's metallurgy is, also due to its history and position in the public consciousness, ArcelorMittal Poland (owner of the former T. Sendzimir Steelworks), which, however, is first and foremost the largest and most modern domestic steel producer, with revenues of over PLN 3.5 billion in 2019 and distribution of nearly 1.5 million tonnes[197]. However, the giant is experiencing problems related to the demanding – according to the new European Green Deal – standards of the EU ETS (European Carbon Dioxide Emissions Trading System[198]). The group of processors may also include Alumetal Group, Metalodlew, Krakodlew, Odlewnia Tarnów. Significant industrial producers include Stalprodukt, Grupa Kęty, KZN Bieżanów, Wiśniowski, Wostal. TELE–FONIKA Kable manufactures products mainly for the power industry and telecommunications. For the consumer FMCG market, packaging is manufactured by CANPACK, which has been one of the largest companies in the region for years. Rock materials are supplied, among others, by the mine in Klęczany. It is worth noting that **the domain grows out of a strong regional tradition.** The access to natural resources caused, as early as in the 19th century, the development of craft centres and education of blacksmiths (Blacksmiths' Society in Sułkowice) and locksmiths (Imperial and Royal Locksmith School in Świątniki Górne). Today, thriving enterprises are located there, e.g. the Sułkowice Forge or the "Przyszłość" Metalworkers' Cooperative. Since the end of the Second World War the Kraków–based Foundry Institute (currently in the Łukasiewicz Research Network) has been part of the domain's back–up facilities, conducting research and implementation activities for the foundry industry. A few years later the Silicate Institute started operating, which was eventually renamed the Institute of Ceramics and Building Materials, also belonging to the Network. Glass and Building Materials Division. Despite such institutional background (in the following part reference is also made to universities constituting the base of scientific knowledge for the domain stakeholders) research and development works are relatively widely performed independently by the enterprises. Apart from the largest and already mentioned players, they are conducted by, among others,[199] Arvex, Ceramit, Drabest, Frezwid, Gór Stal, Komex, Malbox, Promerol, or Rbs Stal.

The regional metal and mineral industry has strongly developed value chain links specific to distribution and sales processes. In 2018, it exported, taking into account sections XIII–XV of the CN classification, goods valued at PLN 7.8 billion, which accounted for

[195] Based on: K. Alajoutsijarvi, et al, Dynamic effects of business cycles on business relationships, *Management Decision,* 50/2, 2012.
[196] *Steel Industry Energy & value chains, The threat to Competitiveness,* presentation by Ian Goldsmith, UK Public Affairs Manager, Corus, Brussels, 2008.
[197] *2019/2020 Raport Roczny, RYNEK DYSTRYBUCJI I PRZETWÓRSTWA STALI W POLSCE*, Warsaw: Polska Unia Dystrybutorów Stali, 2020.
[198] (https://www.wnp.pl/hutnictwo/arcelormittal–poland–nie–podjal–zadnych–decyzji–ws–czesci–surowcowej–krakowskiej–huty,417222.html), [accessed: 30.09.2020].
[199] *Map of Brands, the Małopolska Region*, Warsaw: SAR, 2018.

18.1% of the entire Małopolska Region volume. Extending the list to include section V (Mineral products) will raise these values to – respectively – 8.6 billion PLN and 20%. Sections XIII–XV accounted for 24 of the 100 detailed products with the highest export value. The export leader of the sector turned out to be caps/pins/seals and other accessories for packaging made of base metals worth almost 840 million PLN. According to the classification of Polish Classification of Activity (PKD), the value of export for the production from divisions 23–25 amounted to 7.1 billion PLN[200]. Trade surplus amounted to 2.1 billion PLN[201]. In the same year foreign direct investment for the sections of PKD in the Małopolska Region amounted to approximately PLN 235 million, 2/3 of which fell to ArcelorMittal Poland. The parent company ArcelorMittal was also the dominant final investor; the share of funds brought in by ArcelorMittal Polska constituted almost 4/5 of the capital volume flowing into the region. This unipolar structure of investment outlays translates into the structure of the type of activity supported – external funds have mainly contributed to the relevant processes in the production of pig iron, ferroalloys, cast iron and steel as well as steel products. In total, an estimated 23 entities of the metal and mineral industry were supplied with external capital. In several cases the investor was ArcelorMittal[202].

Several regional companies falling within the domain are implementing investment projects within the Polish Investment Zone. Their activities strengthen various fields, from construction intended for the needs of enterprises and public institutions (Arkan), through treatment technologies (KALI – a relatively recent investment, supported under the KPT decision in June 2020[203]), packaging production (CANPACK), to waste management (Unimetal Recycling). The engineering company ABB, which together with the Kraków University of Technology opened the Centre for Functional Materials and Advanced Manufacturing Processes in mid–2020, is investing in research stations for developing, processing and testing modern functional materials[204]. The Technical University is also the scientific base of the domain in the field of modelling and design of materials, testing of material properties and manufacturing with advanced technologies, which can be found in the offer of the Institute of Material Engineering operating within the university. An even stronger scientific and didactic base for the development of the specialisation is provided by AGH, operating five associated faculties[205].

The current innovation and development potential of the IS is shaped at the level of technologies of raw material production and processing of products as well as reduction of waste generation and recovery. The flywheel of innovativeness is also the competitiveness of the industry in terms of values as well as material and construction solutions. **The Małopolska Region entities from the Production of metals... domain enter trans–regional value chains primarily through traditional industries, however, with a clearly innovative face**. Natural sectors that create demand are transport (branches of foreign companies are located in the region: Valeo, MAN Trucks, Aptiv but also domestic NEWAG), construction (the presence of the national key cluster Sustainable Infrastructure) and machine which is part of the synergic regional domain (RIS 6). The demand also comes from the food industry – CANPACK, the winner of the last edition of the prestigious "Investor without borders"

[200] A year earlier it was PLN 6.7 billion, 2 years earlier: PLN 5.9 billion.
[201] Own calculations based on data obtained from the Tax Administration Chamber.
[202] All BIZ figures are based on MORR's own estimates, carried out in 2020.
[203] (https://businessinmalopolska.pl/aktualnosci/631–male–firmy–duze–inwestycje), [accessed: 30.09.2020].
[204] (https://www.pk.edu.pl/index.php?option=com_content&view=article&id=3531:otwarto–wspolne–laboratorium–abb–i–pk&catid=49&lang=pl&Itemid=944), [accessed: 30.09.2020].
[205] *Charakterystyka 3 spośród 7 dziedzin wytyczonych przez inteligentną specjalizację regionu*, Kraków: UMWM, 2014.

competition[206], is building a plant in Pennsylvania for the production of aluminium cans with the target employment of 400 people[207]. A similar investment in Helmond, the Netherlands, was worth 100 million EUR[208].

Trends, niches and developments with the impact of the COVID–19 epidemic

As a raw material and energy–intensive domain, it is naturally subject to the constraints of such global trends as decarbonisation, the reduction of natural resource exploitation and GOZ. Like Chemistry, it must strive for its image in relation to these challenges. The metal industry has even coined the term 'green steel' as a synonym for environmentally responsible and sustainable industry solutions[209].

High electricity prices and the lack of a levy for non–European steel importers, who are not subject to carbon constraints, are currently the biggest problems for raw material processors[210]. Paradoxically, the industry can benefit from decarbonisation. Several gas pipelines under construction in Europe are generating strong demand for steel, which Polish[211] suppliers are already benefiting from. Over time, this natural resource can (along with OZE, in which the sector must invest) help the raw materials industry meet demanding environmental targets. Investment in the commercialisation of production technology and the use of hydrogen as a fuel may also help[212].

The obvious way forward for the industry is to invest in critical raw materials, i.e. those to which access is a strategic security issue in terms of the European ambition to deliver the aforementioned European Green Deal. Their number is growing rapidly – currently there are 30 on the EU list, compared to 14 a decade ago and the global competition around them is intensifying[213]. On the one hand, the demand for the access to them may trigger investment in new acquisition and processing technologies within the old continent, on the other hand, it will mean the need for partnerships with external suppliers.

Other conditions of the industry are related to the volatility of supply and the high volatility of prices with regards to common raw materials, outside the mentioned list, such as copper[214] as well as significant investment in the neighbouring countries, such as the start–up of a rolling mill in Germany[215] or the mine of the already mentioned copper in Russia[216].

The COVID–19 pandemic does not seem to have a direct impact on the domain as can already be observed for RIS 3 (driver) or RIS 7 (recessive factor). Admittedly, some conservative

[206] (https://www.wnp.pl/finanse/inwestor–bez–granic–znamy–laureatow–prestizowej–nagrody,416010.html); [accessed: 30.09.2020].
[207] (https://businessinmalopolska.pl/aktualnosci/pozostale/1013–canpack–krakowski–producent–puszek–zbuduje–swoj–pierwszy–zaklad–w–usa), [accessed: 30.09.2020].
[208] (https://investinholland.com/news/grand–opening–of–canpack–beverage–can–factory–in–the–netherlands/), [accessed: 30.09.2020].
[209] (https://poland.arcelormittal.com/media/artykul/news/o–wyzwaniach–hutnictwa–na–Europejskim–kongresie–gospodarczym/), [accessed: 30.09.2020].
[210] (https://www.wnp.pl/hutnictwo/arcelormittal–poland–nie–podjal–zadnych–decyzji–ws–czesci–surowcowej–krakowskiej–huty,417222.html), [accessed: 30.09.2020].
[211] (https://www.wnp.pl/hutnictwo/ferrum–dostarczy–rury–na–baltic–pipe–za–ponad–87–mln–zl,411313.html), [accessed: 30.09.2020].
[212] (https://www.wnp.pl/hutnictwo/wodor–nadzieja–takze–w–hutnictwie,416456.html), [accessed: 30.09.2020].
[213] (https://www.wnp.pl/gornictwo/ke–nowa–lista–surowcow–krytycznych–nowa–strategia–zabezpieczenia–dostaw,416765.html), [accessed: 30.09.2020].
[214] (https://www.wnp.pl/hutnictwo/zapasy–miedzi–zmalaly–do–poziomu–najnizszego–od–2007–r,413378.htm), [accessed: 30.09.2020].
[215] (https://www.wnp.pl/hutnictwo/thyssenkrupp–inwestuje–w–blachy–dla–motoryzacji,411721.html), [accessed: 30.09.2020].
[216] https://www.wnp.pl/hutnictwo/rozpoczela–sie–budowa–najwiekszej–rosyjskiej–kopalni–miedzi,411644.html, [accessed 30.09.2020].

decisions may be linked to the epidemiological situation (official position on not activating the blast furnace at the T. Sendzimir Steelworks[217]), but **the real, long–term dependence is likely to be postponed in time and will be the sum of the negative and positive impacts of SARS–CoV–2 on the major economic sectors,** to which the domain has a servile function. A German study[218] suggests that the metalworking industry will be one of four (out of 11 analysed) most negatively affected by COVID–19, which must be followed and analysed with great attention as the said forecasts are becoming more and more plausible.

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

The representatives of the IS entities are subject to a cyclic survey[219], the aim of which is, among others, to evaluate the implementation of the economic strategy of the region based on the IS, to identify barriers, difficulties and needs. In the opinion of the representatives of the Production of metals... domain, the provisions of regional programme documents do not sufficiently reflect the needs of the entrepreneurs, which results in the funds going to industries that were not intended for co–financing. At the same time, a very strong competition is perceived, which means that in order to stand out and increase the probability of a success, projects are directed towards difficult materials (critical or rare earth metals) and to niche and demanding industries. This conditioning seems to drive innovation within the domain. Especially, since the **enterprises operating within such one have developed new technologies and products that would have been unattainable without an access to funds dedicated to the IS. An observed benefit is, inter alia, an access to international markets**.

Entrepreneurs recognise the GOZ–related challenges concerning the future for their industry – an example is the recovery of materials and raw materials that are not commonly traded (e.g. from electro–waste). They anticipate that design processes will be subject to the rigour of reduce&reuse, although a barrier to the development of this principle is the lack of processing technologies for some raw materials. The domain will soon see the adoption of solutions based on virtual reality – both in production and education.

Companies operating within the domain expect higher responsiveness from universities as well as research and development centres[220]. Their experience shows that initiating the project realisation with the university or research unit resulted from the needs of the company, while they would expect an offer for commercialisation, a proposal for implementation, other cooperation or at least a portfolio from the other side. A gap is perceived in the possibility to use tested solutions. On the other hand, the regional administration is expected to make the support framework more realistic – entrepreneurs indicate that the reality, especially the technological one, shows a completely different picture than what results from the documents on the basis of which the support is launched. This suggests the expectation of greater use (even ordering) of current industry expert opinions and narrowing down competitions to the real needs resulting from such ones. Such a finding is confirmed by

217 (https://www.krakow.pl/aktualnosci/238224,26,komunikat,uruchomienie_wielkiego_pieca_przelozone_z_powodu_koronawirusa.html), [accessed: 30.09.2020].

218 *Gospodarka w czasach pandemii. Spojrzenie sektorowe na bazie pierwszych doświadczeń*, Pekao Bank, April 2020.

219 See: https://www.malopolska.pl/biznes/innowacje/badania–i–analizy, [accessed 04.01.2021].

220 The Kraków University of Technology is an example of a welcome response: https://www.pk.edu.pl/index.php?option=com_content&view=article&id=3531:otwarto–wspolne–laboratorium–abb–i–pk&catid=49&lang=pl&Itemid=944, [accessed 30.09.2020].

the results of another study[221] among domain representatives, which identified the following external barriers to development: (a) High specialisation makes formal issues sometimes very difficult, as the product "eludes" available classifications, (b) "Institutions and offices are staffed with humanists" (which, although in a stereotypical way, suggests a lack of understanding with regards to the subject matter and the needs of entrepreneurs).

[221] *Wyzwania i szanse rozwojowe małopolskich* MŚP..., op. cit.

Diagnosis in the domain of Electrical engineering and machine industry

Scope and general nature of the specialisation

RIS6 means **a very broad, horizontal specialisation** that includes several, strongly industry–oriented groups of technologies (medical engineering technologies, innovative technologies, processes and products of the agri–food and forestry–wood sectors, sustainable energy, smart and energy–efficient construction) and broader, "umbrella" areas (innovative industrial technologies and processes, process automation and robotics, visual electronic systems and materials as well as Smart creative technologies, designing).

This domain, in the shape in which it was finally selected and described as a specialisation, was not present at the stage of preliminary analysis of areas that could become IS in 2014[222] (apart from a small section: 27.12.Z Manufacturing of electricity distribution and control instruments). The verification analysis, carried out a little afterwards, indicated the legitimacy of including this domain into the IS catalogue due to the **high values for indicators relating to: value added, labour productivity and production of goods** (ranked among the most important export products of the Małopolska Region). This trend continues, in 2018 the first three places in terms of export value for the Małopolska Region were occupied by the production of electronic components, motor vehicles excluding motorbikes and other electronic components and cables, and this represented 19% of the Małopolska Region's exports[223]. The Electrical engineering and machine industry sector is also highly innovative and stands out in terms of macroeconomic indicators[224]. "Innovation" refers not only to the inventive potential of the sector, but also defines its products, as **some of the products directly support the process automation and robotics** (Industry 4.0). This activity is in line with the latest trends in this area, as industrial development is inextricably linked to robotics[225], which is becoming a necessity. Global demand for solutions supporting robotics will grow.

The domain includes quite a high number of divisions according to the PKD classification: all are elements of manufacturing (this means **concentration on supplying products, although it is surrounded by a number of accompanying services[226]**) and include manufacturing of various types of equipment: computers, electrical and electronic goods (PKD 26), electrical equipment (PKD 27), machine and equipment (not classified elsewhere, PKD 28), automobiles, trailers and semi–trailers excluding motorbikes (PKD 29), other transport equipment (PKD 30) and repair, maintenance and installation of machines and equipment (PKD 33). This diversity of products that are produced within the specialisation also translates into the **multiplicity of value chains that can be distinguished within the domain**. The purchaser of the products can be, both, the public and private sectors, business and individual customers. One of the sectors included in this specialisation is classified as "high technology" industry (division 26: manufacturing of computers, electronic and optical products). In turn, other divisions also have the potential to create technologically advanced products (e.g. robots, autonomous vehicles). It is worth noting that the domain of electrical engineering and machine industry is mostly created by entities standing out in terms of knowledge–intensity,

[222] *Charakterystyka dziedzin...*, op. cit.
[223] Value of exports for the Małopolska Region by PKD code for 2018, Own calculations based on data obtained from the Tax Administration Chamber.
[224] Ibid.
[225] J. Grzeszak, J. Sarnowski J., M. Supera–Markowska*, Drogi do przemysłu 4.0. Robotyzacja na świecie i lekcje dla Polski,* Polski Instytut Ekonomiczny, Warsaw 2019.
[226] E.g. installation, training of personnel in operation, service (a very important part of the value chain).

innovativeness and B+R activity. The key activities and processes determining the generation of value and the position of entities from the Electrical engineering and machine industry specialisation **in value chains are related to production, technology and sales**. **Supply (supply and distribution logistics)** is also important, **both from the point of view of purchasers** of the products offered in the domain (e.g. providing "smart racks" for warehouses, electrical and electro–technical bundles, e.g., for the automotive industry) and **the manufacturers themselves** (entities from the domain, which is connected to increasing their own production efficiency).

Value chains from the perspective of the output of the RIS Working Groups

The specialisation was defined by the IS WG very broadly and one could say horizontally, across the sectors[227]. It includes manufacturing with the greatest potential for innovation of the following: electronic products, optical products, electrical and mechanical equipment as well as the production of vehicles, means of transport and their components. On this basis, **several value chains** can be distinguished**, analogous to the Information and communication technologies domain**. The **strong interrelationships between the domains** are particularly evident in the detailing of specialisations prepared by the working groups[228]. **Synergies can be found in** many technologies: technologies from the Electrical engineering and machine industry domain to develop devices (e.g. Implantable implants, 6.1.1 Artificial organs) and technologies from the ICT domain to develop controllers/software to operate these devices (e.g. Remote monitoring software for artificial organs, 3.1.3 Artificial organs). **In many instances, complete equivalence can also be found**: the same elements are included in both specialisations. In some areas, at the second level of specialisation detail, the specialisations in question contain the same groups of technologies: 3.15.1 Designing: Designing and tools supporting the designing process and 6.7.1 Designing and 6.7.2 Tools supporting the design process; 3.13.5 Machines and equipment that automate and robotise processes and 6.5.3 Machines and equipment that automate and robotise processes), which makes **it very difficult to define the boundary separating the two specialisations** (interpenetration of enterprises, convergence of value chains). This is confirmed by the sector's own definition: **entrepreneurs from the domain often refer to themselves as representatives of the ICT sector** and, as they admit themselves, they have no problems "fitting in" to one of the Małopolska Region's IS, e.g. when applying for support from RPO, because their projects qualify for several at the same time[229]. All these reasons lead to considering Electrical engineering and machine industry as well as Information and communication technologies as horizontal specialisations. It seems justified to link them (as horizontal) more strongly to one another and to communicate them as such, since they contain interrelated value chains.

Value chains from the perspective of IS monitoring

Seven out of the 77 projects for which the Electrical engineering and machine industry domain was indicated as the first assignment were simultaneously linked to another field within the domain. The most frequent parallel linkage was noted for the field Sustainable energy, Smart and energy–efficient construction as well as Innovative technologies and industrial processes. The former seems to absorb the latter (in construction – especially energy–efficient

[227] Within the study *Inteligentne specjalizacje województwa małopolskiego...,* op. cit.
[228] Ibid.
[229] *Jakościowe badanie małopolskich przedsiębiorstw...*, op. cit.

construction – sensorics has direct, indispensable applications), which is a model example of the signalled inseparability. Single cases (seven) of simultaneous linking of a project with a field from another domain was also identified, but it is difficult to find any significant regularities in them.

Potential for specialisation in the light of monitoring and inclusion into GVC

The field structure of the number of projects is dichotomous – **three out of seven fields are clearly over–represented** (most strongly Process automation and robotics, which was assigned to almost 1/3 of 155 projects), while **the remaining four fields constitute the area of a relatively small number of projects** (an extreme case is the domain of Optic electronic systems and materials, in which no project was included). The aforementioned division into two parts is even more striking, as the domain is characterised by high semantic coherence of the fields – the field categories are mostly formulated as groups of technologies (although sometimes directly industry–oriented). This allows them to be considered fairly equivalent in terms of depth. The field Sustainable power industry, Smart and energy–efficient construction, which is defined broadly, even across the sectors, is clearly inseparable from the entire Sustainable energy domain (RIS 2).

The previously mentioned field as the one most frequently developed with project, Process automation and robotics, **has an above–average (both within the domain and across all IS) success rate of** 55%. A lower success rate (49%) was found, among others, in the field Sustainable power industry, Smart and energy–efficient construction, where an almost identical number of applications were submitted. The highest success rate (68%) in the domain have projects in the field Innovative technologies, processes and products of the agri–food and forest–wood sector, which, however, due to the small supply, translates into only 13 implementations.

What must be emphasised is that the Electrical engineering and machine industry uses solutions developed within the framework of RIS 5 (Production of metals, metal products and non–metallic mineral products), and in the case of some fields of this domain (e.g. Innovative technologies and industrial processes) it is possible to talk about **essential benefits for the development of innovativeness of the electrical equipment manufacturing industry, transport equipment or the machine industry**. Therefore, it is justified to strengthen and support links between the domains.

Enterprises operating within this specialisation are highly diversified. These are entities with high innovation potential, but above all with a great significance for the economic development of the Małopolska Region – **a large part of them are exporters**. In this context it is worth mentioning above all the production of electronic components and electrical and electronic equipment for motor vehicles (e.g. Zakład Elektroniczny Omega, EC Engineering, Sumera Motor), production of motor vehicles and other transport equipment (NEWAG, Zasław TSS, WESEM, MAN Trucks), production of general–purpose machines (EC Systems, Fideltronik), other electronic components and electrical wires and cables (e.g. Zakład Elektroniczny Omega, Pawbol, Ligwan, Grupa TELE–FONIKA Kable, MANEX). Some companies that offer highly specialised products (e.g. refrigeration equipment – Bolarus, CEBEA, Igloo, Juka and ES SYSTEM K, or heating boilers – Protech, Stalmark) have **an export–oriented strategy,**

which results from the fact that the domestic market is too narrow[230]. The strategy of many companies is also directed at establishing **broad cooperation with foreign partners** who have highly developed technologies at their disposal, as they have appropriate B+R facilities (e.g. Germany, USA, Taiwan).

It is also worth noting that the entities operating within the domain are part of GVCs in many industries. An example is Fideltronik, which offers its products for the industrial, medical, lighting, automotive, telecommunications and white goods sectors for multinationals such as Bosch, ABB, Philips and Ascom. Another example is Wamech, a company providing machine systems used to improve the operation of enterprises in various sectors, such as trolleys, platforms, turntables for such international companies as: Valeo, Daimler, Johnson Control, BEHR. Foreign concerns such as APTIV (the technical centre in Poland is one of the largest in the world), ABB (cooperates very intensively with AGH, PK and UJ), ATB Tamel and Valeo also have their headquarters in the Małopolska Region. The ability to **offer products for different sectors ensures relatively high flexibility** in the event of a crisis or a downfall in a given sector (e.g. for example, the COVID–19 pandemic worsened the situation in the automotive sector[231]; a company like ABB develops solutions for both the automotive sector and several other sectors, including pharmaceuticals, which received a boost during the pandemic).

Companies that offer products which remain part of Industry 4.0 (e.g. Fideltronik, Industria Polska Sp. z.o.o., TFM Robotics, Asset Electric, DS–Technic Automatyka Przemysłowa) are important entities that determine the importance of this specialisation in GVC. Robotisation is an important element of the value chain, allowing for a significant increase in manufacturing process efficiency and product quality.

The domain has a rich background for development in the Małopolska Region, due to the existence of a strong scientific base (including AGH, Kraków University of Technology), which, on the one hand, is a partner for cooperation, and, on the other, provides the market with qualified employees. Despite the fact that students are educated in the fields which respond to the industry's demand, **according to entrepreneurs the needs are much greater than didactic possibilities of local universities** and they concern not only production departments but also service departments (maintenance). An important advantage of the region in the context of automation and digitalisation of industry is the presence in the region of one of the five national DIHs (Digital Innovation Hubs), which are to support entrepreneurs in digital transformation (the role of the Małopolska Region DIH will be played by KPT).

Trends, niches and developments with the impact of the COVID–19 epidemic

Electrical engineering and machine industry, as a specialisation, fits into important global trends. An example is **Industry 4.0**, which, as already indicated, is one of the directions growing in strength (especially as there is now an even stronger emphasis on including further aspects of industry under the management of Artificial Intelligence – Industry 5.0)[232]. The support provided so far in the region from the RPO resources perfectly reinforces this trend, as a significant number (1/3) of the projects within this specialisation received support within

[230] In the case of certain industries (e.g. boilers), such a strategy is shaped, inter alia, by legislative restrictions imposed from the national and regional level.
[231] Cf. (https://polskiprzemysl.com.pl/raporty/rynek–motoryzacyjny–w–polsce–w–dobie–pandemii/), [accessed: 22.09.2020].
[232] It should be noted, however, that the pace of development for domestic industry is uneven and many companies are not yet ready for Industry 4.0 solutions, cf. (https://www.sztucznainteligencja.org.pl/przemysl–4–0–czy–5–0–efni/), [accessed: 18.09.2020].

the field focusing on Process automation and robotics. **Electric and autonomous vehicles** constitute another trend. As the analysis of the entities has shown, the Małopolska Region has many strong (and often home–grown) enterprises that supply components or manufacture this type of vehicles (Newag, Aptiv).

For the moment, the sectors most affected by the COVID–19 outbreak are undoubtedly the automotive sector, due to the collapse in demand (disruption of supply chains, financial problems of customers)[233] and the fact that it is also a sector heavily dependent on foreign capital and oriented towards exports. To a somewhat lesser extent, the computer and electrical equipment manufacturing industry, for which a large group of companies supplies products and which is one of few industries very strongly involved in GVCs, has been affected[234]. However, one should be rather optimistic about the future, as these industries are key to the development of new technologies, which seems to be a more sustainable trend than the one resulting from the pandemic. In addition, many players supply products to many industries and, thus, occupy a place in many value chains, which makes it **possible to maintain a relatively stable economic situation**.

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

It is worth emphasising that the **support provided** so far from the **RPO resources has met the needs of enterprises in this specialisation**. A large number of enterprises represent the MŚP sector and have problems with demonstrating a high level of innovation. Therefore, some of them adopt a dual strategy: production of traditional goods, for which they have their permanent markets, and, additionally, offering innovative products (where there is a lot of competition and uncertain markets). This is where public funds are extremely helpful, making such activities possible. However, as emphasised by entrepreneurs, it is highly problematic to obtain bank guarantees, which are sometimes a requirement for obtaining co–funding[235]. Running this type of activity requires cooperation with scientific entities, with which it is still not easy to cooperate (a number of institutional and mental barriers). Entrepreneurs indicate that it is much easier to cooperate with individual scientists, employed on the basis of various types of contracts: a specific task, commissioned work. In order to be able to conduct innovative activity, it is necessary to have an access to the latest knowledge and technical achievements and, on the other hand, to have an opportunity to present one's own products to a wider group of recipients, which makes it possible to gain new contractors and feedback necessary for further improvements of the product. An opportunity to do so are various trade fairs and conferences, for which entrepreneurs could receive co–financing from RPO funds. A certain difficulty in using the funds for this purpose is the fact that support must be applied for well in advance, and it happens that the decision to receive it comes after the deadline of paying for the participation in the event. Lack of flexibility in this respect is indicated as one of the main problems.

Another difficulty that entrepreneurs (especially in the industrial sector) complain about is the **lack of qualified middle–level employees**. Production plants are becoming increasingly automated, which requires new qualifications and competences that are rarely taught in branch

[233] *Gospodarka w czasach pandemii,* op. cit.
[234] Ł. Ambroziak, J. Chojna, J. Gniadek, H. Kępka, J. Strzelecki, *Szlaki handlowe po pandemii COVID–19*, Polski Instytut Ekonomiczny, Warsaw 2020.
[235] *Jakościowe badanie małopolskich przedsiębiorstw*...– 2019 edition, op. cit.

schools and technical secondary schools. The **lack of manpower** definitely hinders full–scale operations.

Diagnosis in the domain of Creative and leisure industries

Scope and general nature of the specialisation

The Creative and leisure industries specialisation constitutes **a very broad domain** combining four, relatively specific fields focusing on: 1) cultural industries (film, audiovisual, music, publishing, fashion, media and advertising, performing arts), architecture and conservation of works and monuments, 2) design (industrial design and graphic design, but also widely understood designing using user experience including e.g. information structures, interaction) with particular emphasis on the furniture industry developed in the region, 3) video games industry as well as multimedia and audiovisual tools serving creators and their audiences, and 4) "premium tourism" connected with modern information and communication solutions, health services, catering and education services. The differentiation of the domain is evidenced by the fact that **it is nested in the business activities of entities classified in at least[236] five different sections of the PKD** (R – Activity related to culture, entertainment, recreation, J – Information and communication, I – Accommodation and food service activity, M – Professional, scientific and technical activity, N – Administrative and support service activity). At the level of subclasses related to the domain, earlier analyses[237] distinguished almost 30 PKD codes, which did not even include creative activities related to culture and entertainment (PKD division 90), including individual creators anyway. Nevertheless, it was indicated at that time that, respectively, almost ¼ of entities were those related to activities in the field of architecture and engineering; technical research and analyses (section 71 of the PKD), and more than 1/5 conducted activities related to software and IT consultancy and related activities (selected subclasses of section 62 of the PKD)[238]. It should be stressed that, in principle, apart from accommodation and catering, in the case of the domain we are talking about either high **technology services** (divisions 59–63 and 72 of the PKD) **or knowledge–based services,** e.g. divisions 71 (architecture), 73 (advertising), 90–93 (culture, recreation and sport)[239]. They are, therefore, characterised by high added value, building their value first of all on information and ICT, human, social and cultural capital. The term "creative capital" is also used, associated with the "creative class"[240].

Value chains from the perspective of the output of the RIS Working Groups

The detailed description of the domain includes four fields (it is the narrowest one among all the domains) of various "depth" – from very capacious, expandable categories in the Creative industries field to a very detailed field of Computer games and software (Interactive leisure software). A brief introduction to the description of the fields emphatically highlights **the dominant value in the chains created within or with the participation of specialisation – the production and exploitation of intellectual property**. Due to the presence in the domain of many different branches of economy and a rich cross–section of economic activities, the mutual arrangement of the fields is a great advantage – it is generally successful, as it clearly distinguishes the fields: 1) dedicated primarily to creators, artists[241] 2) dedicated to designers

[236] Referring only to the level of domain fields, as at a more detailed level activity profiles from yet other sections of the PKD appear, e.g. Section E for catering waste management.
[237] *Charakterystyka 3 spośród 7 dziedzin*, op. cit. .
[238] Ibid, p. 39.
[239] *Nauka i technika 2018,* op. cit., p. 203.
[240] R. Florida, *Cities and the Creative Class,* Routledge, New York – London 2005.
[241] In the case of creators, the final recipient of a product or service is the viewer, listener, reader, etc. However, there is a distinct lack of definition of the scope of specialisation within the domain in relation to business recipients: publishing houses, producers,

and production engineers, 3) dedicated primarily (but not exclusively) to game developers, software developers, programmers, testers and media processing specialists and 4) dedicated to tourism organisers and representatives of the tourism sector. However, from the perspective of existing and potential value chains, such an arrangement seems problematic in several places. The first debatable point is the placement of architecture among creative industries covering chains of cultural goods, the "production" and distribution of which takes place within a different type of economy branch, with the participation of entities of a definitely different profile. Although one should not deprive architecture of its culture–creating value and proximity to art, it rather shares the value chain of the field of design and industrial design, in which solutions are designed, among other things, for the needs of industrial processing or construction. Within this field, it is interesting to highlight the position of the furniture industry, competitiveness of which can indeed be increased through, among other things, the individualisation of production, i.e. a kind of reorganisation of the value chain from designing through production to customer service. However, it seems important **to think more broadly about designing and design, combining the activities proposed under RIS 3 and RIS 6** (mainly designing support tools, but also RIS 4 – smart packaging) **into a coherent value chain.** Another measure, justified by the specificity of the processes, the value chain separateness and the growing economic position of the sector, is the separation of the video games sector from the Creative industries field. It should be noted, however, that the Interactive Leisure Software field covering this sector in its details also includes technologies, methods, tools and solutions concerning audiovisual activity and multimedia, which are not software and require a different kind of knowledge and skills (e.g. research methods and tools, business models) and, above all, seem to support the value chains created within the Creative industries field. It is also problematic that the details in this area are not disconnected from the contents of the RIS 3 description. **Hence, at least a partial revision of the domain scope and related fields is recommended**. The field that clearly goes beyond the domain boundaries in terms of linking value chains is the leisure time industry (inter alia linked to Life science through health services or healthy eating). It is also the field that makes most use **not only of cultural (especially traditional) but also natural resources**.

Value chains from the perspective of IS monitoring

13 out of the 90 projects for which the Creative and leisure industries domain was indicated as the first assignment were simultaneously linked to another field within the domain. The most frequent parallel linkage was recorded for the Creative industries field, which was co–occurring on a similar scale with graphic design and industrial design as well as Computer games and software. Only two cases of simultaneous linking of a project with a field from another domain were identified, which shows that **although the fields of the discussed domain are a favourable space for extending and strengthening value chains from other IS** (first of all, Graphic design and industrial design have such properties), **within its field scope, the domain presents itself, so far, as internally complementary and relatively independent**. As mentioned before, the problem from the point of view of IS monitoring in the region is a clear lack of separation of the detailing content for selected fields of the domain under discussion from RIS 3 (Information and communication technologies). Moreover, the

record companies, etc. – The lack of detailed directions of technology development makes it impossible in this case to make any attempts to indicate the key links and potentials, the shape and length of the value chain, the desired recipients, etc.

previously mentioned Designing and design is mentioned explicitly in RIS 3, RIS 4 and RIS 6 (and it can be assumed that it is indispensable in other domains as well).

Potential for specialisation in the light of monitoring and inclusion in GVCs

The structure of the number of projects carried out within the four fields of specialisation is relatively homogeneous, but a pole can be distinguished. **45% of the 172 assignments connect the projects with the field of Graphic design and industrial design**, the other three fields include from 13 to 22% of the projects. The predominance of this category is undoubtedly related to its interdisciplinary character and the possibility of simultaneous assignments to other fields, regardless of the domain. It is not hindered by a rather narrow, sectoral definition. The next two fields, in terms of the number of assignments (Creative and leisure industries,) are, in turn, formulated relatively broadly, in a way including a number of industries, with such rich collections as artistic activity or tourism. The domain that attracts the fewest projects, Computer games and software, on the one hand, limits the potential realisations to a relatively narrow industry in terms of meaning, and on the other, contains the aforementioned particularities (audiovisual activities, multimedia) that go beyond the field and potentially strengthen the other fields within the domain.

The success rate clearly differentiates the fields. It turns out that **the abundance of projects in the field of Graphic design and industrial design is connected with the success of applications (61%) in RPO competitions**. The least prepared (33% success rate) seem to be projects from the field of Computer games and software. This turn of events at the evaluation stage means that the ratio of completed projects between these fields is much higher (7/2 in favour of Designing...) than the ratio of submitted projects (7/4), **which is a clear demonstration of the applicants' potential**. Across the domain, the success rate almost matches the average for all specialisations.

The creative industries of the Małopolska Region have been subject to quite an exhaustive study in recent years[242], which has aimed at describing their state and conditions for development[243]. The report from the study indicated, among others, the **growing potential and importance of two industries: computer games and software as well as the media and advertising industry**. In 2010–2016, these were the fastest–growing creative industries in the region, contributing relatively the most to PKB and employing relatively the highest number of people[244]. Unfavourable trends, however, affected the publishing industry[245]. From the perspective of the year 2020, while speaking about the "existing state" of the potential for creative industries in the Małopolska Region, we should state, above all: 1) the still distinctive game[246], software as well as media and advertising industries (about which, see for more below), 2) the still strong architecture industry[247], 3) graphic design and industrial design, which stand out in terms of the demand for funding and opportunities for potential cooperation with other domains, and 4) the great potential of the leisure time industries, based on unique cultural and natural resources as well as on opportunities for interregional, including cross–border,

[242] With regard to the fields of the IS domain, it should be noted at the same time that the survey did not cover the leisure industries.
[243] *Małopolskie przemysły kreatywne – stan i warunki rozwoju*, UMWM, Kraków, 2018.
[244] Ibid, pp. 32–33.
[245] Ibid.
[246] It is estimated that within a year at the utmost, the Polish WSE will become the largest "trading floor" in the world for gaming companies, overtaking the Tokyo Stock Exchange, cf. (https://kolumna24.pl/blog/news–prezes.gpw.wkrotce.bedziemy.najwiekszym.parkietem.na.swiecie.je–30837.html), [accessed: 09.09.2020].
[247] The cited 2014 the Małopolska Region IS domain study indicated a significant share of architecture entities among the domain entities, while the cited creative industries study reports a further 1–2% increase in the number of entities after 2014.

cooperation. However, it should be stressed that in the face of the COVID–19 epidemic, the leisure time industries, in particular tourism and catering, are exposed to very painful changes and losses that are difficult to reverse[248].

Bearing in mind that the main value generating resource in creative industries chains is intellectual property, in the context of the regional competitiveness and GVCs, it is worth noting that this value is created mainly through locally available resources. The region, especially Kraków, is **trying to ensure an access to educated and talented employees, the presence of universities educating in creative faculties** (including, for example, Computer Games Informatics at the Faculty of Physics, Astronomy and Applied Computer Science at the Jagiellonian University or the Computer Graphics and Multimedia specialisation at the Kraków University of Technology) and **a varied educational offer** (formal and non–formal). Using the games industry as an example, it can also be stated that, both, the national level (successful recruitment to the GAMEINN sectoral programme) and the regional level (e.g. Digital Dragons conference, Digital Dragons Academy, Digital Dragons Incubator at KPT) manage to provide effective support for creative industries. The KPT mentioned here is also a good example of a creative industry organisation with a broad offer adjusted to the needs of the industry, which translates into effective operations of the companies. In the case of the games industry, this is both an office offer, an access to technical infrastructure, knowledge (including industry research), an incubator, educational and promotional activities. The institution has also coordinated the Digital Entertainment Cluster. The effect of the aforementioned activities is the numerous presence of representatives from the Małopolska Region in the industry. CD Projekt, the publisher of, among others, The Witcher and Cyberpunk 2077, listed on the WSE, and several companies listed on NewConnect, including Bloober Team, 7levels, Polyslash, One More Level, Moonlit or Starward Industries, have had their offices in Kraków since 2013. Apart from the process of **production of titles with the chance for global reach**, promotion and distribution, in particular within foreign markets, remains an important element of the value chain for the industry. Industry events, such as the aforementioned Digital Dragons and others, may serve to establish the cooperation. Despite the hermetic character of the field connected with games, it is worth noticing that **their promotion often includes other creative industries in the value chain, e.g. the music industry**[249]. **One creates opportunities for the other**. It is worth emphasizing that apart from entertainment games, games with business applications[250] (simulation games; their creators come together and are promoted by the Edutainment Cluster) are developed, so are other products and services from the field of modern multimedia technologies (in recent years, these have included VR goggles (Vrizzmo) or educational applications (Duckie Deck, and now, above all, Brainly).

As for the media and advertising market, **advertising agencies serving large corporate clients** (e.g. Eskadra Group, Opus B, Hand Made) and event companies (e.g. Visualsupport) **play an important role, marking their presence in GVC.** Kraków is the home to such well–

[248] There is talk of – conditioned, however, by intensive public support for the sector – the possibility of rebuilding the sector in the 2023–2024 perspective, cf. text by Z. Bartuś in Gazeta Krakowska of September 2020: https://gazetakrakowska.pl/turystyka–w–krakowie–przechodzi–ciezki–zawal–straty–sa–ogromne–a–ich–odrabianie–potrwa–wiele–lat/ar/c3–15167126, [accessed: 08.09.2020].

[249] An example is the role of the death metal band Vader, known abroad, promoting CD Projekt's "The Witcher" in its song *Sword of the Witcher*.

[250] Customers and users of products and services of the edutainment type are not only the representatives of business, but also, for example, the sector of education and higher education. Simulation games developed by the cluster members are used at faculties related to management, among others, by the Higher European School in Kraków.

known media brands as Grupa Onet, Interia (recently acquired by Cyfrowy Polsat) or Grupa RMF, which belong to foreign media corporations.

Graphic design and industrial design entities can operate in value chains within the domain, as well as outside such one, cooperating with various industries, including more traditional ones. Despite the high demand for designers in Poland, in comparison to such countries as Denmark, Finland, South Korea, Germany, Ireland or Sweden, there **is no systemic support for industrial design**, consisting in, among others, improving education, incentives for companies, or systematic research over the field[251]. It is true that the Małopolska Region's universities educate on design (e.g. the Faculty of Mechanical Engineering at the Kraków University of Technology, the Faculty of Industrial Forms at the Academy of Fine Arts, Pedagogical University), but the needs seem to be greater. Nevertheless, there are also entities designing for others (e.g. ergodesign, Grupa Projektowa od Rzeczy, Metodesign), as well as designing and producing their own series of utility objects, e.g. toys (Bajo). An interesting example of combining design with other areas of the domain (Leisure industries) is the activity of SLOConcept, designing and constructing skate parks and pump tracks (the company prides itself on 800 concepts of such facilities in Poland and abroad, including Lithuania, Norway and Russia). The Centre of Creativity and Design in Kraków was supposed to support the growing importance of design, but the initiative has not been implemented[252]. As shown by the previous studies in the region[253], architecture has a major role to play, not only in terms of the position of the analysed domain, but also in the development of RIS 2, in particular in the field of Energy–efficient, smart buildings and cities. Underestimated in the domain description, yet a valuable element of the value chain linking architecture and design, is interior architecture (studies in this field are conducted at the Academy of Fine Arts in Kraków). This is important because **new trends in interior design, ergonomics and functionality have a knock–on effect on many sectors and industries, e.g. construction, furniture, textiles and others**.

Due to the high fragmentation of entities in the domain, both in relation to creative and leisure industries, cluster initiatives and clusters themselves constitute an important element in strengthening the regional potential. The analysed domain has the highest number of identified cluster initiatives of all the domains of the Małopolska Region IS[254]. However, **they** usually do **not show sufficient sustainability** (one of very few positively distinguished cases is the Kraków Film Cluster).

Summarising the potential of specialisation from the perspective of value chains**,** it is necessary to recommend the **need for an in–depth diagnosis of the chains for the Creative industries field**, including the details of the development directions planned by specialisation stakeholders. In the case of other fields, both their interconnectedness and potential for cooperation with other domains should be highlighted.

[251] *Sukces w zawodzie projektanta wzornictwa przemysłowego: czynniki i mechanizmy wpływające na efektywną współpracę między projektantami i przedsiębiorcami wdrażającymi nowe produkty na rynek oraz kształtujące rozwój kariery zawodowej projektanta*, Instytut Wzornictwa Przemysłowego, Warsaw, 2017.
[252] Cf. *Ewaluacja mid–term wdrażania Regionalnej Strategii Innowacji Województwa Małopolskiego 2020. Raport końcowy*, FuRBS, Kraków, 2020.
[253] *Sieci współpracy..*, op.cit.
[254] *Aktualizacja pogłębionej diagnozy…*, op.cit, p. 142.

Trends, niches and developments with the impact of the COVID–19 epidemic

A worldwide trend that is changing the creative industries very intensely includes **digitisation**. It affects, among other things, a change in the way we communicate with clients or even the emergence of new sectors or subsectors of the economy (e.g. e–museums)[255]. The possibilities and applications of **3D printing and Augmented Reality *(*AR)** are still being explored. Digitalization is followed by **customization and personalization of services**[256]. In the case of the analysed domain, it is evident that new technologies in value chains not only provide new opportunities for organising logistics of resources and materials or for modernising services, but also significantly change the way goods are promoted, sold and distributed (e.g. self–publishing). Other trends and meta–trends relevant to the domain include Artificial Intelligence (used e.g. in online communication and advertising), Virtual Reality (VR), Multi–screening (parallel display) or the **development of the fashion sector towards wearables**[257]. Due to the complexity of the creative industries sector, there are obviously many more trends and niches specific to each industry or type of business.

An important trend from the perspective of the strongest sector in the domain (games) involves the **growing popularity of e–sports**, i.e. individual or team competition in computer games (not necessarily of a sporting nature). **New value chains are being created around e–sports, in particular games and events,** including broadcasting rights, prize founding, admission fees etc. – It is enough to mention that computer game championships are watched by more than 250 million people worldwide[258], while the European e–sports audience is estimated at 86 million people[259]. The aforementioned partial self–reference of the domain (one field within it, strengthens the position of the other one) is also evidenced by reports that in Poland the popularity of e–sports suddenly increased after the launch of the Polsat Games TV channel in 2018[260]. A 2019 Deloitte study found that **Poles are among the top European countries in terms of regularity in watching e–sports games**[261].

The situation for domain actors is noticeably modified and differentiated by the COVID–19 epidemic. One can speak within the domain of "winners" and "losers" of the epidemic time. On the one hand, **leisure services are among the industries identified as most affected** (the need for downtime)[262]. In particular, the cultural sector, tourism and related services (accommodation, catering) have been hit hard by the fall in demand[263]. **Tourism is a particularly vulnerable sector to epidemic threats**[264]: falling demand is compounded by administrative restrictions limiting the mobility (especially between countries)[265]. On the other hand, there has been an **acceleration in the development of innovative educational services (the so–called EduTech industry[266])**. The epidemic has largely "migrated" cultural

[255] *Think Creative,* Canon, 2016.
[256] Ibid.
[257] *Creative economy outlook. Trends in international trade in creative industries 2002–2015*, UNCTAD, 2018.
[258] (https://itreseller.com.pl/rosnie–popularnosc–e–sportu–rozgrywkami–coraz–czesciej–interesuja–sie–najwieksze–globalne–koncerny–ktore–napedzaja–wzrost–branzy/), [accessed 09.09.2020].
[259] (https://www.press.pl/tresc/58268,Europejski–rynek–e–sportu–w–2018–roku–byl–wart–240–mln–euro), [accessed: 09.09.2020]
[260] Ibid.
[261] *Let's Play! The European e–sports market*, Deloitte, 2019.
[262] *Gospodarka w czasach pandemii...*, op. cit.
[263] *Gospodarka w czasach pandemii...*, op. cit.
[264] PARP, *Identyfikacja instrumentów wsparcie dla rozwoju sektora turystyki*, 2020 (https://www.parp.gov.pl/storage/publications/pdf/Raport_sektor–turystyka_13_05_2020.pdf), [accessed: 01.09.2020].
[265] Ł. Czernicki, P. Kukułowicz, M. Miniszewski, *Branża turystyczna w Polsce. Obraz sprzed pandemii*, Polski Instytut Ekonomiczny, Warsaw 2020.
[266] See *Koronawirus a gospodarka – które branże zyskują na pandemii?*

activities and the educational system to the digital space. In the case of education, several Polish companies have managed to turn the difficulties associated with it into success, such entities including Skriware (a start–up producing 3D school printers and educational robots and creating an online platform for teachers), NovaKid (a start–up supporting children in learning English) or Brainly from Kraków (a start–up making it easier for students from all over the world to do their homework). Of course, **the epidemiological situation also strengthened the games industry** – during the pandemic the industry achieved the record sales of online games[267].

Benefits, barriers, difficulties and needs from IS stakeholders' perspective

The specificity of working in the creative and leisure industries means that the range of potential opinions, viewpoints, problems and needs can be very wide. However, there are some common elements. First and foremost, the creative sectors need a background in the form of a **"climate" favourable to creators** – the possibility to present their achievements, to stand out on the competitive market, the existence of a market for their products and services. This is what is meant by a kind of "staginess" of places: towns, cities, districts, etc. and "the eventness" – "the taking place". It is important to have facilities in the form of scientific and cultural institutions and opportunities to develop creative skills. A critical factor for running business activity and adopting a business model by creators is the knowledge in the area of entrepreneurship, copyright law and intellectual property as well as personal qualities[268]. The importance of this is indicated by the opinions of the entrepreneurs surveyed from the domain, who indicated, among other things, **problems with the local perception of creative activities** (associating Kraków mainly with tourism), **numerous and strong competitors** or **difficulty in selling a characteristic product, such as an idea**[269]. In another study, the issue of profitability of using funds offered within the framework of regional measures for representatives of the domain was strongly emphasised. In the opinion of the respondents, the relation of potential profits to the necessity to incur costs (including those related to administrative and financial services of projects), time invested and extensive bureaucratic procedures makes the **offered support unattractive[270]**. Nevertheless, financial resources for promotion, internationalisation and increasing the scale of operations for entities are desirable. Less desirable activities include support for cooperation with universities[271]. Another significant problem, **despite the available specialised education, is its insufficient scale in the case of the needs demonstrated by the games and software developing industry**. Companies from the sector have problems finding suitably qualified employees and, in connection with this, the employees take advantage of the high demand for their work by increasing their salaries; the staff turnover in the sector is also significant[272]. However, what appears to be the

(https://startup.pfr.pl/pl/aktualnosci/koronawirus–gospodarka–ktore–branze–zyskuja–na–pandemii/), [accessed: 01.09.2020]. Interestingly, the use of intellectual property in the form of exploitation of domain knowledge (as it is, for example, in online education) was only tentatively hinted at in the domain description.

[267] See (https://itreseller.com.pl/gaming–po–roku–2020–najszybciej–rozwijajaca–sie–galezia–przemyslu–rozrywkowego–na–swiecie–covid–19–tylko–ja–wzmocnil–rekordowymi–wynikami–sprzedazy–wynika–z–raportu–polskiego–think–tanku–4/), [accessed 01.09.2020]. (https://oxfordbusinessgroup.com/news/video–games–and–covid–19–impact–emerging–markets); (https://www.weforum.org/agenda/2020/05/covid–19–taking–gaming–and–esports–next–level/), [accessed 01.09.2020].

[268] Such as organisational skills, perseverance, risk taking, openness to innovations, cf. *Małopolskie Przemysły kreatywne,* op. cit., p.141.

[269] *Wyzwania i szanse rozwojowe...*, op. cit., pp. 10–11.

[270] *Jakościowe badanie małopolskich przedsiębiorstw...*, op. cit.

[271] Ibid. A possible and potentially important field of cooperation, however, could be the consultation of curricula with representatives of the sector.

[272] *Ocena wsparcia udzielonego w ramach działania 1.2 PO IR na rozwój wybranych sektorów gospodarki*, IBC GROUP/FuRBS, Warsaw/Kraków 2018, pp. 53–54.

most difficult challenge and the greatest need for parts of the domain is **the support for the leisure industries and for those exposed to the risk of bankruptcy or being takeover as a result of the epidemic crisis**.

5. Strategic analysis of the domains of the Małopolska Region smart specialisations

Analysis in the domain of Life science

Due to Life science domain being knowledge–intensive and highly technologically advanced, the region's competitiveness and innovativeness can be supported primarily through: **further investment** in 1) infrastructure (laboratories and their equipment[273], research equipment, software, etc.), including laboratory space intended for renting, 2) human capital in the area of medical and natural science, but also technical, international management, knowledge management, intellectual property rights, technology transfer and 3) B+R projects. An a**ccess to an adequate number of graduates** from Life science faculties is of particular importance, hence the promotion of such faculties, monitoring of education paths (at least from the secondary school level) and working with talented students, and at the level of tertiary education, academic entrepreneurship. The potential of the Jagiellonian University Hospital should be used in building cooperation platforms (e.g. with start–ups) focused on finding technological solutions using the research conducted by the hospital and the university. In order to optimally exploit the opportunities in the external environment, it is necessary to promote public funds and initiatives related to the **involvement of the Life science sector in combating threats and effects related to the COVID–19 epidemic and other potential epidemic threats** that may occur during the implementation of the RSI. Including the context of the epidemic and other civilisation challenges concerning public health, it is necessary to take care of the increase in opportunities for cooperation between different IS fields (e.g. through the organisation of interdisciplinary competitions, pro–innovative procurement of public sector entities, pre–commercial procurement) and internationalisation of the offer provided by the entities from the domain (primarily through **support and strengthening the position of clusters in the domain**). Among the desirable directions of support (in line with the possible development and strengthening of value chains between the fields from different domains) will be the stimulation of cooperation between the entities from the IT, ICT and cyber–security sectors with producers and service providers from the Life science sector[274]. A desirable horizontal activity, important both from the point of view of the Małopolska Region's image as a bioregion, as well as the needs of start–ups**,** is the **promotion of good practices, examples, success stories** connected with the implementation of projects or operations of the entities from the Life science domain. The term "bioregion" should also be based on an in–depth (necessary) analysis of the possibilities for creating value chains based on healthy food – its production, processing and marketing. In addition, promotion and an offer to attract foreign investment to the region, e.g. from the pharmaceutical sector, will be helpful.

Analysis in the domain of Sustainable energy

The specificity of RIS 2 Sustainable energy, from the perspective of business and social objectives, is that **these objectives are mostly "on the site" –** technologies and solutions developed have the potential to be implemented on a large scale within the regional market (which of course does not exclude activities on a wider scale, including international presence),

[273] Which applies to both companies and universities, especially in the context of creating conditions for international cooperation.
[274] Another example of a level of cooperation between domain actors is air quality, which is a challenge from a health perspective, but also for the development of air purification technologies, e.g. by actors in the Sustainable energy or Information and communication technologies domains.

within value chains differentiated by buyer, type of products and services. Within the domain "there is room" for activity in a more innovative chain, based on B+R as well as a more imitative one, based on competitiveness in terms of: quality of the product offered, material, design (e.g. buildings), marketing, sales and after–sales service or, finally, price. The territorial dimension of specialisation should encourage intensive contacts and cooperation between stakeholders linked by geographical proximity, including, among others, the promotion of distributed power generation. Actions aimed at this domain should support the objective of transforming the region into a more ecological and energy sustainable one, thus, it will be very important to **continue environmental education**[275] among the youngest, to develop **social campaigns** dedicated to renewable, dispersed and prosumer energy, networking events, in particular as part of strengthening the activity of clusters and knowledge centres (similarly to Life science) and **support in promoting the activities of companies** – suppliers of products and services in the field of OZE and widely understood energy efficiency. With a view to more serious technological challenges, it is necessary to design and moderate **cooperation of a pipeline nature** with entities shaping the demand for technological solutions and possessing implementation capabilities; in the case of the Małopolska Region these are, in particular, entities such as Grupa Tauron, MPEC S.A. in Kraków or PEC Geotermia Podhalańska S.A. It is worth supporting the development of projects, including start–ups which at the appropriate level of development will have a chance of business cooperation with such entities[276], which, in turn, will translate into a greater share of innovative technology implementations in the region. Actions targeting the domain should take into account the fact that Sustainable energy, in particular prosumer energy, also spreads over other specialisation domains (RIS 3, RIS 6). Particularly valuable activities for the domain, especially in its more advanced fields, may be those that will **increase the scale and effectiveness of knowledge transfer within academic entrepreneurship**. Producers and service providers with a ready–made, competitive solution should be **encouraged to expand into** domestic and foreign markets.

Analysis in the domain of Information and communication technologies

Further support for the ICT industry remains justified because it has developmental potential and, moreover, it helps other industries to operate, e.g. by optimising costs, reaching customers (websites)[277]. Companies from other industries, looking for savings, turn to the IT industry, which helps to increase efficiency with fewer expenses[278]. It is worth focusing on support solutions (within competitions[279]) offered by the ICT industry, especially for other regional specialisations[280], which may turn out to be **an important developmental stimulus for companies from other domains**. For this purpose, however, it is necessary, from a formal point of view, to **treat the ICT industry as a smart specialisation of a horizontal nature**. It

[275] In this context, the Eco–start project, (http://www.ize.org.pl/projekty/eko–start/), [accessed: 01.09.2020], implemented with funds from the Regional Fund for Environmental Protection and Water Management in Kraków, can be indicated as a good practice. Actions related to environmental education, also in the field of OZE, have been carried out since 2016 as part of the LIFE integrated project "Implementation of the Air Protection Programme for the Małopolska Region" carried out by UMWM (Department of Environment) and 62 the Małopolska Region communes. They will be continued under the new LIFE integrated project "Implementation of the Regional Action Plan for Climate and Energy for the Małopolska Region".

[276] Hence, it may be worthwhile to involve representatives of such companies as experts evaluating projects at earlier stages of development.

[277] *Charakterystyka dziedzin...,* op. cit.

[278] Ibid.

[279] An interesting solution could be e.g. an ICT solution voucher for companies from different IS domains or low–interest or non–refundable technology loans (cf. https://ccnews.pl/2020/04/14/po–pandemii–sektor–ict–moze–stac–sie–kolem–napedowym–polskiej–gospodarki/), [accessed: 22.09.2020].

[280] A distinction should be made between activities based on the use of existing solutions and systems, and activities requiring significant effort, e.g. for designing algorithms or adapting solutions to a given application domain.

is expected that the **region will remain relatively flexible in its support for ICT projects, e.g**. due to the development of completely non–typical services within its core business. Entrepreneurs perceive the need to link the variability of the conditions and environment with the possibilities of changes in the project. The ongoing changes in the economy, when confronted with the implementation of a several–year project, make it practically impossible to smoothly and quickly change the project without a large burden of additional work for the personnel in the company[281]. Due to the indicated information needs, it is desirable to **intensify information activities in the scope of European funds for the ICT industry** (to a much lesser extent for start–ups). On the information side, it is also necessary to **promote innovative solutions developed in the Małopolska Region IT–related sector** among entrepreneurs from other IS domains (here, it is necessary to develop tools for sharing information). The sector should also be supported by strengthening the processes leading to the internationalisation of business, e.g. through the **participation of enterprises from the ICT sector in trade fairs and industry events**.

An important category of planned activities should include **multidimensional support for start–ups**. One of the forms that should be taken up is the support for improving the qualifications of staff in start–ups within the ICT sector, in particular in areas with the greatest potential for development, such as deep tech. This is because they face a problem in finding qualified staff[282]*.* Anticipated support should take into account the potential of the Małopolska Region start–ups (in comparison with other regions) especially in the areas such as **Internet of Things (IoT) or Big Data**[283]**. It should include closer cooperation with universities. Acceleration programmes** such as #StartUP Małopolska[284], which have proven to be an effective and efficient support tool, **should also be continued.** The activities of the Kraków's DIH and **horizontal activities related to digitisation and development of the region's ICT infrastructure**[285], which will enable further development of the ICT industry – both among entrepreneurs (potential users of these solutions) and residents (customers using the offer of ICT companies), will be important for the domain. It is also justified to develop the infrastructure (including office space) in order to use the potential of medium–sized cities (e.g. Tarnów, Nowy Sącz) to locate service centres such as BPO, SSC, IT, B+R[286].

Analysis in the domain of Chemistry

The specificity of the Małopolska Region chemical sector, resulting, among others, from its ownership structure, requires consideration of the level of support for the stakeholders of the specialisation appropriate for the region. Actions important from the perspective of the region are also taken from the national level (an example is the project Polimery Police by Grupa Azoty[287]). The starting point should be – again – a synthesis of factors determining value creation and the position of the entities from the specialisation Chemistry in value chains. They are related to: a) adapting products to consumer needs (this adaptation should result from

[281] *Jakościowe badanie małopolskich przedsiębiorstw... – 2019 edition*, op.cit.
[282] M. Beauchamp, J. Krysztofak–Szopa, A. Skala, *Polish Polskie startupy. Raport 2018*, Fundacja Startup Poland, Warsaw 2018. Staffing needs are also evidenced by the increasing number of employees employed in them especially the most dynamically developing ones e.g. Base (200 employees in employed in Kraków), Sales Manago (170) Brainly (75), Estimote (70), Kontakto.io (70), Synerise (70), cf. B. Józefowski, Raport: startupowy Kraków 2017, #OMGKRK, Kraków 2017.
[283] Ibid.
[284] (http://www.startup.malopolska.pl/), [accessed: 08.09.2020].
[285] *Charakterystyka dziedzin, op. cit.*
[286] Por. K. Gwosdz i in., *Potencjał miast średnich w Polsce dla lokalizacji inwestycji BPO/SSC/IT/R&D : analiza, ocena i rekomendacje*, Ministerstwo Inwestycji i Rozwoju, Warszawa 2019.
[287] (https://www.gov.pl/web/aktywa–panstwowe/grupa–azoty–rozpoczyna–spektakularny–projekt–polimery–police), [accessed: 04.09.2020].

professional monitoring of consumer trends on a global scale in sectors which are recipients of the sector's products) b) searching for development niches (in particular, allowing for gaining a position of the market leader), c) adjusting enterprises to regulations and standards (including those related to environmental protection), d) ensuring efficient logistics in terms of an access to and acquisition of raw materials, and e) conducting interdisciplinary B+R work, used by the entities representing the chemical sector. The desirable courses of action should therefore include direct or indirect support for enterprises with regard to, inter alia: a) the need to adapt to regulatory requirements (certificates, etc.)[288], b) the creation of new products adapted to consumer needs[289], c) co–financing of B+R work[290], d) an access to organic and inorganic raw materials. In this case, as in the case of B+R work (where it is important to be able to **use the support of other entities and companies that are able to support the Małopolska Region companies**, including institutes, private companies and foreign entities), networking and establishing international relations is important. This may be facilitated by the **participation of the region in thematic initiatives under the S3 Platform in Chemistry** (S3Chem Interreg Europe[291]). In monitoring the specialisation and PPO, it may be beneficial to include new entities, current members of the Polish Chamber of Chemical Industry[292].

Analysis in the domain of Production of metals, metal products and non–metallic mineral products

The production of the metal industry in Poland has been on an upward trend for 9 years, with a growth rate of +6% in 2019[293]. The domain based on and closely integrated with this industry has equally stable prospects, whereby this guarantee mainly results from the "traditionality" of the sector and its inseparable (even in the long term) ties with the pillars of the economy – construction, transport, or machine and equipment industry. A kind of "inbreeding" of this specialisation, its dependence on raw materials and anchoring in the demand of powerful customers as well as its strategic nature, from the point of view of the state interests, cause that juxtaposition with the term "smart" may leave an apparent impression of dissonance, inconsistency of tone. Meanwhile, **innovation permeates the domain with the participation of many industries that expect high parameters and properties of the products delivered – e.g. electrical engineering, robotics, medicine, ICT.** Stimulating the domain's innovativeness are also, undoubtedly, the demanding ecological and energy–intensive industry standards, leading to the search for new technologies for acquiring, processing and utilising waste. Another factor of the domain innovation potential is the individual customer as a recipient of final products manufactured by the metal industry, demanding, apart from their unique properties, also design qualities. **Taking into account the aforementioned conditions, opening the domain to external business configurations, image change, searching for new challenges in retail markets, meeting climate challenges, creating value based on cultural heritage are the pillars of the potential base on** which the domain should shape its identity.

The domain label, i.e. the content 'Production of metals, metal products and non–metallic mineral products', should be considered as not fully reflecting the spectrum of the value chains

[288] (https://www.kongrespolskachemia.pl/), [accessed: 01.09.2020].
[289] (https://www.pb.pl/prezes–grupy–azoty–sektor–chemii–wymaga–sprawnej–legislacji–wzmocnienia–konkurencyjnosci–i–innowacyjnosci–897459), [accessed: 01.09.2020].
[290] (https://polskiprzemysl.com.pl/przemysl–chemiczny/przemysl–chemiczny–w–polsce–inwestycje/), [accessed: 01.09.2020].
[291] Cf: (https://www.interregEurope.eu/s3chem/), [accessed: 01.09.2020].
[292] Cf: (https://www.pipc.org.pl/czlonkowie), [accessed 01.09.2020].
[293] *Polski Przemysł Stalowy 2020*, Katowice, Hutnicza Izba Przemysłowo–Handlowa, 2020.

that the processes inherent in the domain link in practice and that could potentially link them. The emphasised "manufacturability" obscures the supply of raw materials and the set of techniques for obtaining and processing them. Nor does it include the design, artistic, ecological or high–technology dimensions which, although not in dominant configurations, enrich value chains with activities calculated to achieve competitive advantages. **In order to unify the message and the depth of the labels for the IS domains, it seems reasonable to have an attractive "sloganising" for the Production of metals... allowing to open the domain to new contexts for the creation of these values**. The target standard is set by the slogan Life science. In other regions it is fulfilled e.g. by Green Economy (the Śląskie Region), Quality of Life (the Podkarpacie Region), Interiors of the Future (the Wielkopolskie Region), Machine industry and related sectors in value chains (the Podlaskie Region).

Analysis in the domain of Electrical engineering and machine industry

The Electrical engineering and machine industry specialisation is a domain characterised by high technological advancement and the potential to discover new markets. In this context, **further support from the region should be continued with** regards to: 1) B+R projects, 2) infrastructure (laboratories and their equipment, research equipment, software, etc.), 3) support for cooperation with science, including such one oriented towards establishing individual contacts with the scientists (implementation doctorates, financing of full–time researchers) and didactics keeping up (quantitatively and qualitatively) with the needs of entrepreneurs, 4) support for participation in foreign fairs, conferences but with greater flexibility in terms of spending. As part of the development of Industry 4.0 and improving the competitiveness of enterprises (also those that have not introduced the solutions of Industry 3.0), funds should be planned for digitisation and automation of activities. An important support in the implementation of activities will be the DIH coordinated by KPT, which can, among other things, provide services in the field of technological auditing or assessment of technological readiness for Industry 4.0 solutions. There is also a need for **new instruments that strengthen the cooperation of enterprises with industry education** (patronage/profiled classes, financing of traineeships for students in enterprises, financing of professional courses for teachers and students of basic vocational schools within the industry). It is necessary to strive to increase the specialisation's recognisability in the international arena, to promote the Małopolska Region as a kind of "enterprise basin" offering products and services supporting global technological trends, which will enable entrepreneurs to gain new markets. It will also be reasonable to strengthen the export potential of enterprises by offering funds for the development of export strategies, promotional activities and **strengthening the competence of enterprises in this area**.

Analysis in the domain of Creative and leisure industries

Just as the needs of the representatives of the domain are diverse, the response from the region should be diverse and multi–directional. It is necessary to encourage creativity and **promote creators and their works, e.g. by means of events** (such as Digital Dragons), but in the case of each industry or field of art – in a manner adapted to them[294]. A universal approach is to create creative urban spaces and to stimulate inhabitants' participation in culture[295]. Since individual creators have limited “clout" in reaching the audience, it is worth

[294] A good example of such activities with regard to the film industry is financial support for documentary filmmaking (Filmoteka Małopolska) or co–financing under the Regional Film Fund.
[295] Cf. *Małopolskie sektory kreatywne*, op. cit., p. 142.

supporting them in terms of promotion and competencies (not only in terms of workshops, but also **in terms of e.g. running a business, managing intellectual property**) e.g. through binding initiatives – clusters, networks, platforms or even cyclical events. The activity of clusters within the domain could focus on the development of more intensive contacts between the representatives of its various fields. The region itself **can create demand for creative services directly**, through various types of commissions, orders and competitions, by promoting the use of creator–friendly contracts (anti–abuse) **and indirectly**, by supporting professional groups and related public services characteristic of the creative class (e.g. doctors, teachers, scientists, journalists), which stimulates demand for creative industry products and services. It is recommended to review the domain in terms of the content of detail, to address the issue of duplication of specialisation scope from RIS 3 and to put more emphasis on the identification of value chains linking the fields of the domain and their elements (e.g. architecture, interior design) to other domains. **Care should be taken to ensure a practically–oriented education of sufficient numbers of students** for the growing games and software sector as well as to increase the education of design professionals. In order to make optimal use of cultural and natural resources, in particular for the development or reconstruction of post–pandemic leisure industries, it is worth considering more courageous, **more intensive interregional and cross–border cooperation**, in particular with Slovak border regions, to develop joint tourism products[296]. More attention should be paid to **supporting the EduTech industry and the growing trend of e–sports**. The priority, on the other hand, as far as the need for urgent and decisive actions is concerned, seems to be the **recovery of the leisure industries**, optimally combined with their stronger re–orientation in the directions planned within the specialisation.

[296] A good and commercially successful move in recent months has been the launch of cross–border bus services to Slovakia.

6. RSI WM 2030 intervention areas, strategic objectives and measures

The RSI 2030 strategy was designed in such a way as to constitute de facto the RIS3 strategy of the Małopolska Region at the same time. In this way, the postulate resulting from the mid–term evaluation of RSI WM 2020, indicating the need for such integration, was fulfilled. RIS3, i.e. the strategy of smart specialisations, thus sets the main perspective for the formulation of the areas of intervention proposed in the document. The starting point is the strategic diagnosis taking into account primarily the seven initial specialisation domains of the Małopolska Region. At the same time, RSI WM 2030 integrates with the RIS3 perspective (in connection with smart specialisations of the region) the selected activities in the area of education, entrepreneurship, competitiveness, digitisation or the circular economy, included in the SRWM 2030.

The search for "common denominator" for the results of the strategic diagnosis led, as a result of the strategic analysis, to the selection of three areas of intervention (OI) (OI1 – Innovative background, potential and image of the region, OI2 – Innovativeness and industrial transformation of enterprises, OI3 – Trust, ties and diffusion of knowledge within the innovation ecosystem – Entrepreneurial Discovery Process [PPO]), covering eight strategic objectives and a set of action groups assigned to them. The development of specific support schemes, formulas (competitive, non–competitive, etc.) and criteria is entrusted to the institutions implementing the Strategy. These are, above all, DZPO WM (responsible for the implementation of RPO 2021–27), MCP and WUP, as well as operators and animators of the PPO and institutions responsible for the implementation of national and transnational programmes (in this case, rather than entrusting, we should talk about joint research, development of schemes, formulas and criteria), with the participation from potential beneficiaries involved in the process. It is important to follow the guidelines resulting from the main assumptions of the RSI WM 2030 (the relevant guidelines were defined in Chapter 9).

In addition to the new general principles influencing the details regarding the implementation of individual activities, undertakings and strategic projects (e.g. concentration on elements of the value chains relevant to individual IS, flexibility, taking into account proposals for changes formulated from the level of the PPO), their division into two categories of activity is also a novelty:

1) addressed to selected domains of the Małopolska Region IS, to solve specific, sometimes sector–specific[297] problems or development challenges (**entity–problem/sector approach**) and

2) addressed to other domains of Małopolska IS, activity of which goes far beyond the borders of a single sector and is aimed at supporting social, economic and technological processes of universal character (**horizontal approach**).

In the case of the first category, a relatively close and targeted (in the period under examination) character was diagnosed in relation to three domains of the Małopolska Region's

[297] Perhaps the most distinctive example is the leisure industries in RIS 7 – based largely on the tourism and catering sector, as a regional specialisation they benefit from resources available only in a specific location, moreover, they share specific problems related, inter alia, to the long–term effects of the COVID–19 epidemic.

IS: Life science (in particular within the chain referring to health and quality of life), Sustainable energy and Creative and leisure industries.

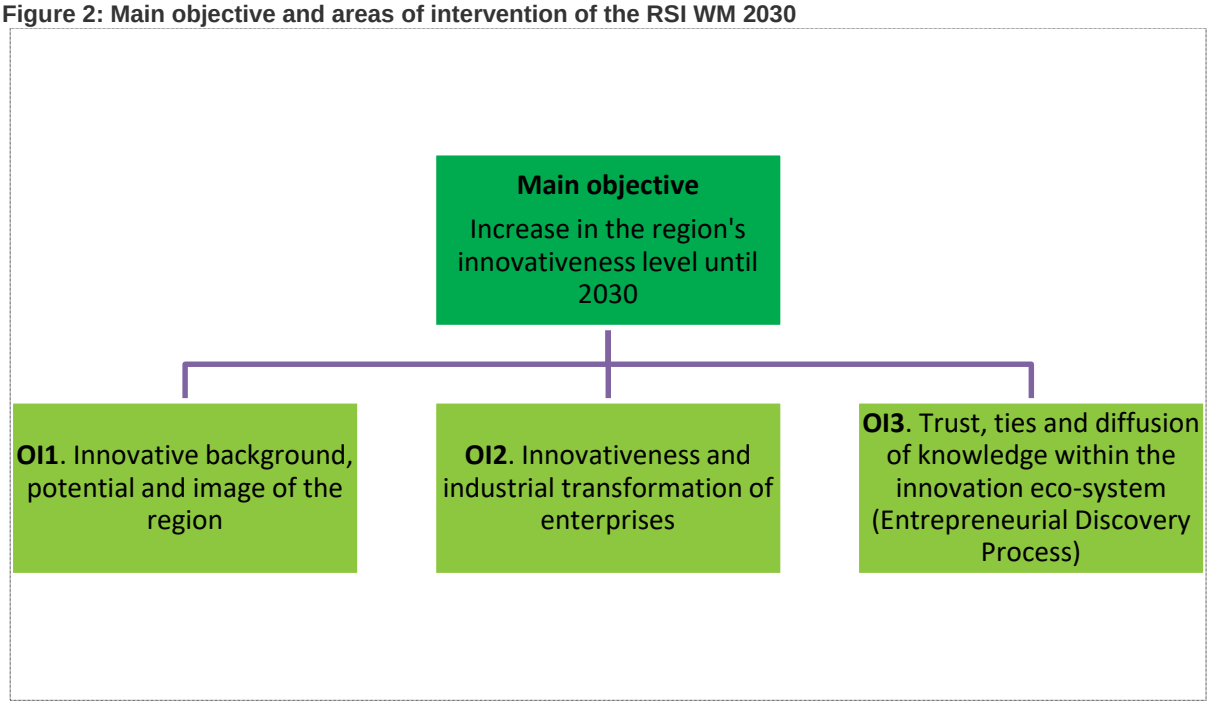
In the case of the second category, the horizontal specialisations were considered to be: Information and communication technologies, Chemistry, Production of metals, metal products and non–metallic mineral products, Electrical engineering and machine industry. They show a high potential for linking with one other and feeding specialisations of a more distinct, sectoral character with their solutions. This makes it necessary to take into account, with regards to this group of specialisations and in order to use the potential for cooperation and synergy, the instruments of support adapted to their nature (including, among others, those that reward interdisciplinary cooperation: research, implementation, marketing, etc.). Horizontal approach concerns also the following areas and processes: education, entrepreneurship (including services for business, characterised by increasing cross–sectorality), digitisation, cyber security, bio–economy and GOZ, internationalisation and foreign cooperation. In the case of this group, all IS domains are expected to be covered (although to a different extent and with different tools[298]).

The above mentioned division also affects the desirable character regarding the process of designing intervention tools: specialisations and horizontal areas require a broad, interdisciplinary discussion and taking into account different, sometimes clashing, points of view (which requires appropriate tools for animation and consultation), while the entity–problem approach should be based mainly on a deeper understanding of the nature of difficulties or challenges (in which the involvement of experienced stakeholders is crucial).

The diagnosed challenges, previous activities and the current position of the Małopolska Region among EU regions in terms of innovation ("moderate innovator"[299]) mean that the region, in the perspective until 2030, should strive to increase the level of innovation in many aspects. It is crucial to look for new, effective ways for current utilization of the innovative potential (which is reflected in the adoption of the value chain approach and the new formula of PPO) while simultaneously strengthening growth factors in the long term. All this contributes to the proposal of intervention areas and strategic objectives formulated below. In the case of descriptions referring to planned groups of activities, it should be emphasized that **they serve to clarify the intentions behind individual actions and do not constitute a closed catalogue**. The influence of regional actors (authorities, scientific community, entrepreneurs, social partners) on the implementation of some of them may be more or less limited, while the scope of influence will reflect the construction of the demarcation mechanism between the national and regional levels.

[298] E.g. in relation to internationalisation – for representatives of some specialisations, international research cooperation may turn out to be more important, for others participation in fairs, foreign expansion, etc.
[299] Cf. profil Małopolski in the *Regional Innovation Scoreboard* 2019.

Figure 2: Main objective and areas of intervention of the RSI WM 2030



In the case of the main objective, it primarily results from the nature of RSI and serves for the implementation of one of the objectives set out in SRWM 2030 ("Innovative and competitive economy of the Małopolska Region"). It is assumed that the main driver of growth in the competitiveness of the regional economy will be innovation resulting from, among others, effective cooperation of entities from the domains of smart specialisations within the value chains (co–)created in the region.

Area of intervention 1 – Innovative background, potential and image of the region

This area assumes taking actions and implementing projects that build up or strengthen the innovative potential of the region in the long term. This concerns both the creation of technical infrastructure facilities (in particular for B+R and innovation activities) as well as broadly understood intellectual resources based on universal competencies of the future and competencies specific to smart specialisation of the Małopolska Region. These resources (access to infrastructure, its development and equipping, development of human capital), along with a strong brand of the region on the domestic and foreign market are desirable, sometimes key elements of value chains in which the Małopolska Region IS entities participate (enterprises, universities and other research units, IOB and other stakeholders of the specialisation).

Strategic goal 1A – Developing the technical infrastructure that supports and stimulates innovative activity

Proposed actions and projects

- 1A.1 Construction and equipping of "smart" B+R infrastructure, facilities, laboratories and studios (including universities), living labs, etc., with a high degree of configurability, adaptability to changing needs, serving potentially various users

  New infrastructure[300] may not only provide functionalities necessary for the development of the fields of the Małopolska Region IS – the process of its design and construction may itself be a developmental stimulus in the chain leading from architectural design, through construction to equipment, metering and then making the offer available. Apart from construction of new facilities (in case of a justified need) in the whole region, their reconstruction/extension, change/development of functions, retrofitting etc. should be supported.

- 1A.2 Development of telecommunications and ICT infrastructure in the entire region

  It is necessary to pay attention, in the first place, to zones and locations without stable access to the ICT network, in particular part of rural and mountainous areas. Trends intensified during the COVID–19 epidemic related to moving work and education to the Internet may lead to an increase in digital exclusion of part of the region's population. A prerequisite for the development of enterprises and science related to, among others, Industry 4.0, IoT is 5G Internet infrastructure. While planning the activities, it is necessary to coordinate the regional level with the national level.

- 1A.3 Extension and modernisation of infrastructure for economic, scientific, technological and cultural events[301]

  The measure aims to increase the attractiveness of the region and the capacity of regional economic entities to organize events, especially of trans–regional or international character, to strengthen or complement their digital infrastructure (e.g. cultural entities, event and exhibition industry). It also includes strengthening opportunities for cooperation and economic, scientific and artistic exchange in the region, e.g. by building, modernising and supporting fablabs, showrooms (including the mobile ones), highly configurable office spaces or shared spaces for business meetings. It takes into account

[300] Its planning should be long–term and credible (e.g. through partnership agreements, letters of intent, etc.) in terms of its effective use – it should earn its keep in the long term and should not be a burden to the budget of its holder.
[301] In this measure, as in the case of smart B+R infrastructure, it will be necessary to make the needs credible from the perspective of potential recipients.

the creation of creative urban/public spaces serving artists (including such ones for the purposes of artistic residencies) and stimulating residents' participation in culture.

Strategic objective 1B. To develop the competences of the future within formal education and lifelong learning

Proposed actions and projects

- 1B.1 Support and promotion of vocational education and in–service training of teachers, coaches, training staff, including, in particular, the field of entrepreneurship, sciences, technology and natural sciences

Projects addressed, both, to training staff from outside the formal education system and to teachers – those already teaching a given subject (e.g. trainings developing digital skills, new teaching methods) and those preparing to teach a new subject, e.g. postgraduate studies. Organisation of high quality "master classes" for teachers. It is also reasonable to organise campaigns promoting the teaching of entrepreneurship, science subjects and shaping pro–innovative competences.

- 1B.2 Development of substantial and managerial competences for the science sector, IOB and the staff managing the innovation policy of the region (including, inter alia, management of competences, innovations, intellectual property, technology transfer, team, risk, age)

The action provides for the implementation of high quality trainings, courses, study visits and postgraduate studies devoted to various aspects of management in the innovation ecosystem, increasing the professionalization level of human resources in the institutions co–creating the ecosystem.

- 1B.3 Talent acquisition and training in formal education and coordination[302] of talent development programmes

Actions are planned to encourage pupils to study in the Małopolska Region, graduates of fields of study related to the Małopolska Region IS to settle down and/or take up employment in the Małopolska Region[303]. Development and improvement of work systems with gifted pupils and students, direct support of gifted pupils and students as well as the cooperation of primary and secondary schools and universities in talent monitoring[304]. Searching for talents also concerns searching for candidates for teachers, e.g. for education in a given industry. It is also desirable to promote and develop cooperation of vocational education institutions with employers (practical vocational training, customized education profiles, patronage classes) and to promote the employment of practitioners – employees of companies for practical training in basic vocational schools. New programmes of apprenticeships, student placements, internships[305]. High quality training programmes and courses co–organised by universities and the practitioners' community (business, NGO, etc.).

- 1B.4 Development of entrepreneurial competences of inhabitants, including competences for just transition processes

Activities related to the popularisation of access to knowledge in the field of entrepreneurship and business, courses, counselling services and information on the possibilities of financing entrepreneurship within the territory of the Małopolska Region communes (including rural areas).

[302] Understood primarily in terms of monitoring development and efficient flow of information about talents: gifted pupils, students, using experiences and lessons from previous programmes, such as "The Talents of the Malopolska Region".
[303] With particular emphasis on cities losing their socio–economic functions.
[304] An example of a project of this type is: (https://www.th–owl.de/en/studies/before–beginning–your–degree–program/talent–scouting/), [accessed: 24.10.2020].
[305] Consideration could be given to entrusting the development and coordination of such programmes to clusters, business organisations.

The support structure should be staged and enable the beneficiaries to receive more and more specialised assistance, and the managers to monitor the effects. Development of entrepreneurship teaching in primary and secondary schools. Supporting the processes of adaptation to changes on the regional labour market through adjusting the qualifications of employees (in particular from the mining sector) to the needs of employers.

- 1B.5 Development of digital competences among the inhabitants of the region

Activities addressed to a wide range of recipients (including rural areas) – from students learning e.g. robotics, programming, algorithmic thinking, using and co–creating media, through training in digital techniques and solutions addressed to representatives of public administration, to teaching adults, combating digital exclusion (in particular among the elderly and the disabled) and organizing social campaigns promoting digital competences. Using the potential of the Małopolska Region DIH (hub4industry) in educational, training and promotion activities.

Strategic objective 1C. Strengthening the brand of the region as a centre of innovation

Proposed actions and projects

- 1C.1 Support for organisation of economic, scientific, technological and cultural events of a national and international range

It foresees activities allowing for further development of existing initiatives, strengthening their recognition and brand as well as creating new events, formulas, formats, in particular related to the fields of the Małopolska Region IS. This also includes joint activities of clusters, chambers of commerce and industry and organisations of entrepreneurs, etc. which fit in with the objective of strengthening the brand of the region as a centre of innovation.

- 1C.2 Support for investment attractiveness of the region, in particular in IS domains

Creation and activation of Economic Activity Zones within the entire Małopolska Region, strengthening their organisational abilities, especially in terms of attracting investors (Polish and foreign ones) that fit into the Małopolska Region IS, and improving the quality of investment area management. Economic promotion of the region, taking into account potential inter–regional and international cooperation within the Małopolska Region IS value chains. Programmes teaching foreign companies and young entrepreneurs how to operate on the Małopolska Region market[306]. Support for economic promotion of the Małopolska Region communes and systematic building up the standards of entrepreneurs' service on every institutional level through ensuring conditions for the functioning of the Małopolska Region Investor and Exporter Service Forum. Supporting the promotion of the Polish Investment Zone as an element of the regional offer directed to investors. Emphasizing the scientific potential in the region's offer, using the promotional "contribution" of the Małopolska Region scientific entities.

- 1C.3 Activity of the “Business in Małopolska” Centre in the scope of comprehensive investment offer of the region

Supporting the activities of the “Business in Małopolska” Centre as a partner of the Polish Investment and Trade Agency, which runs an integrated system of services for investors and exporters (one – stop – shop), in which MARR, WM and KPT cooperate.

- 1C.4 Raising awareness regarding the positive translation of organisational attitudes and cultures into regional innovation

[306] Good practices have been developed in this respect under projects such as "Soft Landing" (national level) or "Come back with POWER!" (the Małopolska Region).

Strengthening those who run campaigns to raise awareness of this correlation and offer training to raise awareness of it. Support should focus on non–urban areas and environments.

Area of intervention 2 – Innovativeness and industrial transformation of enterprises

In this area, an offer of direct support is formulated, which is tailored to the needs of entities and is of a financial, informational, advisory and competence–related nature, allowing for enhancing the widely understood[307] innovativeness, competitiveness and for changing the model of activity towards a neutral impact on the environment and the GOZ. The implementation of the objective is connected with using opportunities resulting from financial leverage (public funds) creating the so–called incentive effect[308]. In the case of schemes for support for innovation and competitiveness, applicants will be required or rewarded to demonstrate their participation in the value chain(s) related to the area of smart specialisation of the region (at any level of the chain). Preference will also be given to indicating the impact of co–financing on the creation of a finished product or marketable solution in the chain from an idea through research to implementation and sale of the solution. Cooperation of the sectors: public, scientific and enterprises, for example, in the form of the implementation of technology vouchers (including such ones for digitization, automation, robotisation) of research projects, including joint B+R projects of companies with universities will support – as a fundamental objective – innovativeness and industrial transformation of the Małopolska Region enterprises.

Strategic goal 2A. Strengthening B+R activity of innovative enterprises

Proposed actions and projects

- 2A.1 Co–financing of B+R projects[309]

  The detailed offer of support for B+R projects should be developed in a way ensuring the fullest possible complementarities with the support offered from the national level and the European programmes, while matching stages of technology development and corresponding support instruments and striving to ensure continuity/possibility of continuing the financing. The offer should also include projects related to the reduction of the impact of economic activity on the environment and/or implementation of GOZ assumptions. Projects may be submitted both individually as well as in partnerships, e.g. enterprises, enterprises and universities, etc. Projects implemented individually by universities or other state research units (research institutes, scientific institutes of the Polish Academy of Sciences) should have a diagnosed, confirmed and credible interest in research results on the part of enterprises[310]. The actions may also include the implementation of B+R work results in enterprises.

- 2A.2 Vouchers[311] for the preparation of project applications to KPO and EU programmes

  Funding for the work of MŚP to develop project applications for national funding not available at the regional level and for European programmes, in particular Horizon Europe, Just Transition Fund.

[307] In line with the current Oslo methodology – including organisational and marketing innovations.
[308] This means a situation in which public support is necessary for a project to have a chance of being realised.
[309] In particular, at the medium level of technological advancement (at least technology verification in laboratory conditions – TRL 4), and in the case of projects implemented by universities or entrepreneurs together with universities, in particular at the early stages of industrial research (TRL 2 and 3). Projects requiring technology tests in laboratory conditions may take the form of e.g. vouchers to be used in accredited units.
[310] Preference should be given to the operations of the enterprises concerned in the Małopolska Region.
[311] The proposal to use tools in the form of vouchers results from the positive assessment of such a form of support by the recipients and the expectations expressed during the public consultation of the draft Strategy. However, the final formula of implementation instruments will be determined as a result of the expectations from stakeholders as well as legal and organizational opportunities prevailing at a given time of the Strategy implementation.

- 2A.3 Sureties and capital support for innovation activities

  Support is offered in different variants, from guarantees for innovative enterprises to equity support from regional VC funds.

Strategic goal 2B. Improvement of the technological level and better management of companies

Proposed actions and projects

- 2B.1 Vouchers for innovations, including, inter alia, purchase and implementation of technologies connected with automation, robotisation, digitalisation of operations by enterprises and institutions, designing and technological verification of business concepts and ordering of specialised B+R works, necessary for the creation of products and services or increasing technological advancement

  Depending on the sector and the operational specificity (e.g. Life science vs. space technologies), different values and conditions for obtaining the voucher (or, as appropriate, other types of support) will be available. Support for innovation understood broadly, including organisational and marketing innovation.

- 2B.2 Vouchers for advisory/consultancy services

  They may concern e.g. technology auditing, business and financial consultancy, scientific consultancy, technology commercialisation consultancy, launch of the first service/product (start–ups), patent process support, compliance with regulatory requirements, internationalisation, digital consultancy – including readiness for digital transformation or implementation in line with Industry 4.0 – cyber security or GOZ.

- 2B.3 Vouchers for professional training of company employees (including, inter alia, digitisation and cyber security) and traineeships of researchers in companies

  Activities to improve professional competences (including digital competence in enterprises) through participation in various forms of lifelong learning (also from abroad: training courses, traineeships, study visits) and knowledge diffusion associated with the implementation of internships for researchers in enterprises. Internships should provide opportunities to strengthen any element of the company's value chain (e.g. logistics, production, technology, sales, etc.). Regional promotion of the ministerial programme for implementation doctorates.

- 2B.4 Development of competencies among the management staff in enterprises and public institutions (including, among others, digital skills, management of competences, innovation, team, risk and crisis, age management)

  High quality, personalised training (including such ones to be held abroad) and funding for postgraduate studies.

- 2B.5 Co–financing of projects concerning the reduction of the environmental impact by economic activity and/or implementation of the principles of GOZ

  Providing support to take advantage of available technologies that reduce the impact of economic activity on the environment (e.g. related to increasing energy efficiency, using OZE, reducing emissions, reusing raw materials, etc.).

Strategic goal 2C. Effective instruments for supporting entrepreneurship and development of enterprise activity

Proposed actions and projects

- 2C.1 Entrepreneurship development programme (including, in particular, setting up and running start–ups, spin–offs in IS domains)

  Projects implemented in the formula of re–granting, covering organisational, training, advisory, mentoring and financial support for start–ups and spin–offs as well as informal groups, individual innovators or independent project initiatives (e.g. indie game studios in the game industry), incubation, pre–acceleration and acceleration programmes including theoretical and practical elements (e.g. study visits, analyses of good practices, etc.).

- 2C.2 Internationalisation of enterprise activities, including support for their promotion and expansion on new markets

  Funding for the development of international strategies, expansion into foreign markets, participation in international exhibition events and foreign economic, scientific, technological events.

- 2C.3 Promotion and support for innovation development in rural areas and mining areas (the Zachodnia Małopolska area)

  Dedicated tools, taking into account the specificity of challenges and barriers for innovation (including its understanding) in rural areas and mining areas (the Zachodnia Małopolska area). Maintaining program cooperation of the region's local government with the local governments (including mining communes). Using the collection of knowledge developed in the form of the Małopolska Region Action Plan for the Development of Innovation in Rural Areas[312].

- 2C.4 Support for succession process in MŚP

  Promotion of the subject related to company succession. Advisory and mentoring offer for companies intending to carry out succession within the next few years. Incentives (e.g. in the form of increased amounts of vouchers) in the case of combining succession with a technological change in the company or a change of profile in the direction related to the fields of the Małopolska Region IS. Using experience and good practices gained by WM in the course of implementation of the project "STOB regions – Succession and transfer of business in regions".

[312] Result of an Interreg project with the acronym RATIO, (https://mistia.org.pl/projekty–zrealizowane–1/ratio–regional–actions–to–innovate–operational–programmes–dzialania–regionalne–n), [accessed: 16.12.2020].

Area of intervention 3 – Trust, ties and diffusion of knowledge within the innovation ecosystem – Entrepreneurial Discovery Process (PPO)

The area assumes the implementation of projects and activities strengthening the diffusion of innovation, information and knowledge sharing between the entities of the regional economy. Gaining and sharing knowledge on innovative activities in the region and innovation cooperation, including development of network forms and links between the participants of the regional innovation system, will stimulate commercialisation or non–commercial use of technologies and knowledge. These activities will serve to build and sustain an ecosystem allowing for an active and continuous dialogue between partners of the so–called Entrepreneurial Discovery Process. Common ideas for projects, B+R undertakings, new tools, criteria and conditions for supporting innovativeness discussed in such a dialogue will be the subject of constant monitoring and periodical updating of the offer of public support in the perspective covered by the RSI (the year 2030). A new tool for the implementation of the PPO will be specialisation platforms (open in their nature), allowing for decentralisation of the process, and through integration and collection of information in one channel, for better use of experience of the participating entities, broader cooperation (e.g. between the domains of specialisation of the region), greater creativity and ensuring their greater impact on the offer of support. An important role in providing information directly from the market for the needs of PPO monitoring will be played by the network of regional clusters and IOB. The open nature of the platforms and the possibility of simultaneous operation of entities in several platforms and in their activities should foster the establishment and intensification of the cooperation between representatives of various fields and domains of the Małopolska Region IS, sharing common value chains[313] as well as the representatives of local and business self–government of the Małopolska Region. Implementation of the PPO in the new formula will take into account the sub–regional diversification of the initial domains of the Małopolska Region IS and create an opportunity to reveal new local potentials.

Strategic Objective 3A. Effective PPO management

Proposed actions and projects

- 3A.1 Implementation of PPO animation activities in the region (including review of existing networks, entities, partnerships etc.) based on specialisation platforms (non–competitive project)

  Piloting of specialisation platforms, learning the lessons and adapting the formula to the activities of stakeholders from other IS domains taking into account existing and well–functioning solutions in the innovation ecosystem.

- 3A.2 Support for network forms of cooperation, in particular interregional and international[314], including support for cluster activities

  Collecting and sharing information about the activities of groups, platforms, clusters within regional communication channels. Providing organisational support and patronage for events organised by the above mentioned initiatives. Development of the offer and organisational capabilities of clusters. Encouraging networking activities in Economic Activity Zone.

[313] Achieving such – desirable – state of cooperation between IS can be stimulated e.g. by appropriate competition preferences.
[314] In this context, it is worth observing the direction of development for the new instrument proposed by the European Commission called *Interregional Innovation Investment initiative* (I3), (https://ec.europa.eu/regional_policy/en/newsroom/news/2020/07/30–07–2020–public–consultation–on–interregional–innovation–investment#_ftnref1), [accessed: 16.12.2020].

- 3A.3 Support for business self–governments and strengthening their roles in networking of regional economy, initiating cooperation of large and small enterprises and stimulating knowledge transfer

  Action complementary to specialisation platforms, strengthening the potential of local and regional business self–governments to actively participate in and support the activity of platforms, in particular in the sub–regional and local dimension.

- 3A.4 Development and promotion of tools supporting the flow of knowledge in the region (including in rural areas and with the use of regional and local NGOs, IOBs, business self–government, etc.)

  Creation and sharing of data bases and knowledge bases (concerning e.g. aspects of digital transformation, good practices in the field of implementation of modern technologies), related to the activities of specialisation platforms, Economic Activities Zones and entities using them, support offer within the framework of RSI, accredited service providers, databases of bachelor's, master's and doctoral theses available for entrepreneurs, companies where one can conduct implementation doctorates and their promotion through business self–government, craft organizations, NGOs. Providing access to contact with regional advisors and consultants (direct and remote – interactive).

- 3A.5 Promotion and support for cooperation ensuring the participation of regional actors in Horizon Europe 2021–2027

  Organisation of events, conferences and less formal meetings on the subject of participation in the programme to establish business contacts, create business–university partnerships, etc.

Strategic goal 3B. Increased effectiveness of public institutions in creating conditions for the development of innovation

Proposed actions and projects

- 3B.1 Innovation partnerships, pre–commercial procurement and other innovation–friendly procurement

  Using the new procurement formula – innovation partnership – by the region’s units in public procurement (e.g. related to e–services or other public services and infrastructure investment indicated in the IO1). Promotion of good practices among local governments. Making wider use of pre–commercial procurement and other innovation–friendly procurement, e.g. promoting the use of BIM technology.

- 3B.2 Complementation, strengthening and consolidation of the offer from the Małopolska Region IOBs (including business incubators, industrial and technology parks, innovation hubs, accelerators)

  The action covers both the creation of new IOBs – where needed – as well as the consolidation and merging of offers (but also, where justified, of institutions) to increase the organisational capacity, recognition and scale of IOBs operations. In addition, financial support for new support instruments, programmes, etc.

- 3B.3 Support for the development of innovative ecosystem of the Małopolska Region universities (including the activities of scientific circles, alumni associations, university special purpose vehicles, technology transfer centres etc.)

  Activities aim to strengthen cooperation, mutual trust and long–term ties between the various bodies and units making up the innovation ecosystem of the university, also within individual universities.

Funding of events, e.g. meetings with entrepreneurs, practitioners, distinguished experts, etc., joint initiatives, publications, etc. Support for commercial students projects commissioned by industry and/or JST.

- 3B.4 Development of monitoring and evaluation system for innovation and the Małopolska Region IS (non–competition project)

Support for organisational and technical capacities as well as for development of competences among entities co–creating the RSI WM 2030 monitoring system.

- 3B.5 Active animation of contacts, cooperation and partnerships between large enterprises (including foreign capital) and MŚP[315]

Consultations with large companies seeking innovative solutions and cooperation with start–ups regarding desired technologies, directions of support for start–ups, etc., in cooperation with regional business self–governments. Involving business experts from such entities in the process of evaluating applications.

- 3B.6 Further development of electronic services and interoperable digital platforms (including e–public services)

This includes the public procurement system, spatial information, development of digital public registers, medical information, etc. Dissemination of open data from public institutions for educational, social and commercial use.

- 3B.7 Development of digital competences of local government administration

Development of competencies, training and retaining of IT staff in the local government sector. Support for the development of sub–regional shared service centres for administration.

- 3B.8 Maintaining and developing the region's active participation in international initiatives

Initiating and continuing projects under e.g. the Vanguard Initiative, Interreg projects; acquiring new projects, expanding and organising the data bases for knowledge and good practices originating from the implementation of international projects, cooperation within the ERINN network (European Regions Research and Innovation Network), using the experience and strengthening the international activity of the “Business in Małopolska” Centre.

[315] A valuable experience resource to be used in this case is the ScaleU programme by KPT.

7. Financial plan for RSI WM 2030

At the current stage of work on the RSI, it is not possible to indicate the sum of funds that by 2030 should have been engaged for the implementation of the objectives described in the following document. This is due to the ongoing work on the shape of the national development policy and ongoing negotiations of Multiannual Financial Framework of the European Union for 2021–2027.

By analogy with the RSI 2020, it can be expected that the key, from the point of view of financing the innovation policy, will be:

- Cohesion policy funds for 2021–2027 – regional, national and available from EU level,
- funds available under the Recovery and Resilience Facility,
- funds available under the Just Transition Fund,
- funds from the state budget,
- funds coming from the budgets of the Małopolska Region local government units,
- own resources of companies,
- beneficiaries' own contribution to the projects implemented,
- withdrawn from financial engineering instruments for the 2007–2013 period as well as from financial instruments and repayable assistance for the 2014–2020 period, resources subject to reuse,
- from other foreign sources, including funds distributed through programmes and instruments managed centrally by the European Commission.

8. RSI WM 2030 monitoring system and running PPO

Combining RIS3[316] monitoring with PPO management

The decentralised PPO model, currently being piloted in the Małopolska Region, is characterised by a strong analytical component – the logic of "discovery" includes ongoing generation and updating of a range of quantitative data on regional smart specialisations. At the same time, in the course of the relevant PPO animation activities leading to the consolidation of regional stakeholders of the specialisation domains, a wide range of qualitative knowledge is generated, including project ideas and their associated implementation formulae (Smart Lab canon), identification of challenges for the diffusion of innovation and digitisation (panel interviews) or the seeds and development paths for project contributions to international partnerships. The acquired information is structured and periodically reported in the form of multidimensional analyses of specialisation domains, technological reviews of domains, reports from qualitative research with domain stakeholders or recommendations for adjustments to the scope and detailing of domains. The specialisation annex to the RIS3 Strategy is an umbrella document for all the knowledge gathered in the course of the PPO[317]. The PPO model developed as part of the pilot study will be implemented on a wider scale, taking into account the current dynamics of development regarding the remaining domains.

The tested PPO model to a large extent covered and, at the same time, extended the scope of monitoring for smart regional specialisation carried out in the Małopolska Region so far. Thus, it became an integral and the most extensive (in terms of labour intensity) element of the monitoring for the entire RIS3 (see Figure 3). The adopted success criterion for the implemented PPO model is high, natural activity of stakeholders, guaranteed by their real, highly probable and precisely defined impact on the regional B+R+I agenda. The manifestation of this activity is a wide feedback which, when skilfully enforced and structured, gives a multidimensional insight into the conditions of specialisation domains. The knowledge gathered in the course of the PPO is managed, formatted and transferred for the purpose of RIS3 monitoring by an external, openly selected operator. Ultimately, a mature PPO model will integrate the knowledge from several domains into one IT platform, enabling more efficient animation, communication and comprehensive process management.

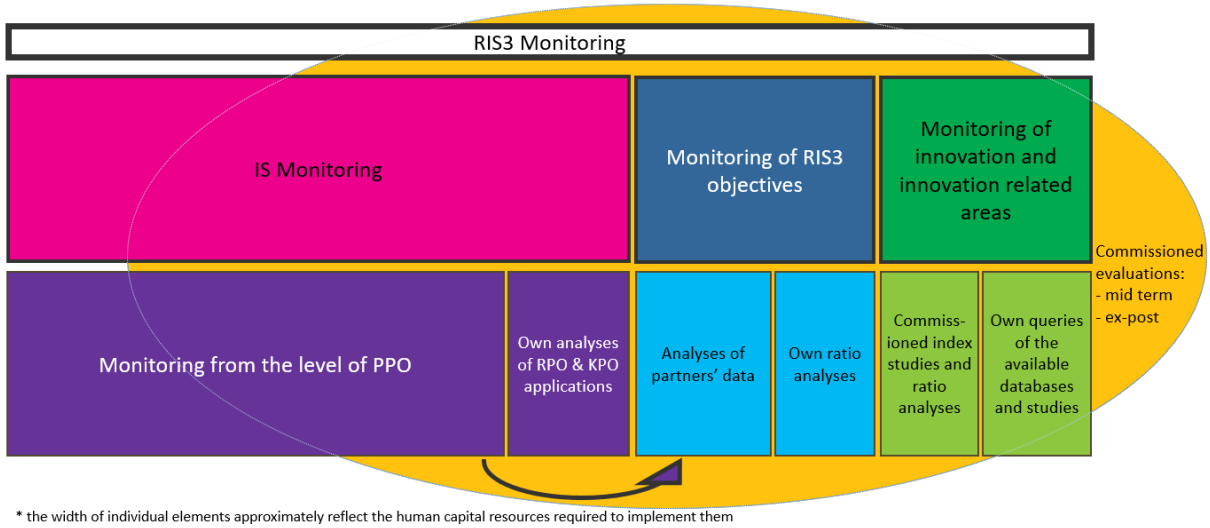
Institutional set–up and decomposition of RIS3 monitoring elements

In operational terms, RIS3 monitoring remains within the competence of the RIS3 Management Team (hereinafter: monitoring unit). This unit, maintaining institutional continuity (responsibility for the construction of a regional innovation system within a project from Measure 8.2.2 of the POKL, then implementation of RIS3 within Technical Assistance for the RPO WM), refers to several years of experience in managing regional innovation. On the basis of practice, the Team has transformed the PPO from an inert, non–responsive formula of the IS WG to the

[316] In Chapter 8, RSI WM 2030 will be consistently referred to as RIS3 (the relation between these terms is presented in the List of abbreviations and in Figure 1). The commitment of this document to fulfil the assumptions of the Research and Innovation Strategy for Smart Specialisation (RIS3), imposes on it extensive requirements for monitoring and conducting the PPO. The unit responsible for these tasks is known as the 'RIS3 Management Team'. This context is crucial for the current chapter and the nomenclature adopted is intended to emphasise it.
[317] The development for the piloted specialisation is planned for the end of 2021.

decentralised model described above. The Team collects the knowledge generated within the PPO and uses it to monitor and manage the Strategy. At the same time, the Team generates, acquires and processes information from the sources other than the PPO. These activities are carried out in the mode of own analyses, external orders and data sharing with partners and are intended, both, to monitor the specialisation domains, supervise the fulfilment of RIS3 objectives and be knowledgeable about the relevant contexts for the implementation of the Strategy. The monitoring unit is also responsible for the evaluation of the Strategy.

Figure 3: Components of RIS3 monitoring system



The team supervises the PPO operator, enforcing the quality and timeliness of studies that form the basis for specialisation monitoring. The PPO involves all the key stakeholders of the specialisation domains – entrepreneurs, third sector representatives, research institutions, IOB, etc. An additional, substantive link between the operator and the stakeholders are the animators – entities whose main activity lies within the scope of the specialisation, which have a broad overview of the specialisation and know the conditions and problems, are strongly integrated with the environment and enjoy its trust. Recruitment to the so–called specialisation platforms (the organisational dimension of the PPO – the vehicle for identifying, networking and animating the environment) is open and permanent. Partners outside the PPO providing regular knowledge for the needs of RIS3 monitoring are the departments responsible for the implementation of European funds, operational programmes management and regional development in the structures of the UMWM and the Małopolska Centre for Entrepreneurship. Information is also collected directly from the implementers of the so–called key projects in the field of B+R+I (included in the territorial contract [in the future probably the programme contract], included in the Polish Road Map for Research Infrastructures, or highlighted in another way – e.g. included in the regional MPI).

In the strategic dimension, RIS3 management, including reception and responsiveness to the findings of the monitoring system, is the responsibility of the Board of the Małopolska Region. Key decisions at this level are made in consultation with the opinion–giving and advisory body for innovation policy of the region – the MRI (the Małopolska Innovation Council), which has been functioning since 2006. The scope of MRI's activities includes, among other items,

consulting RIS3 implementation, participation in the implementation process of the Małopolska Region IS and PPO on a consultative basis, giving opinions on the implementation of innovation policy of the region[318].

The implementation of RIS3, including the monitoring activities, is continuously consulted and editorially supported by an external expert with experience in strategic management and academic expertise in this field. The expert co–creates the content of the Strategy, among others, by co–configuring the monitoring system. At the same time, he/she is a liaison and facilitator between the monitoring unit and the opinion formers and stakeholder groups of the process. In addition, he/she acts as an informant on the process, for the needs of the ZWM. The activity and the scope of monitoring expectations assigned to the expert is adapted to the stage of the Strategy implementation.

The RIS3 monitoring process is strongly conditioned by the expectations of the European Commission. Out of seven the so called basic conditions for launching, within RPO, the financing of interventions covered by Objective I of the Cohesion Policy, two (the first and the third) formulate a direct expectation concerning the RIS3 monitoring, while two others (the second and the fourth) concern the RIS3 management with the use of formulas and activities for which the monitoring is indispensable. A consistent development of competences and human resources of the monitoring unit is planned to meet these expectations and to achieve the analytical potential in order to properly handle the three main elements of the system. The point of reference for the scope of human resources potential needed for efficient RIS3 monitoring are the teams from the regions with similar innovative capacity – the Dolnośląskie Region, the Pomorskie Region, the Śląskie Region. In order to ensure the system's comprehensiveness and coherence, a systematic and formalised use, by the monitoring unit, of the knowledge resources from the partners that have the data necessary for the analyses is foreseen. In consultation with the partners, it is envisaged that the cooperation will be tightened, its scope clarified and its course standardised. The key deliverers for the system are MCP, KPT and a number of units operating within the structures of the UMWM.

Knowledge base for RIS3 monitoring

The knowledge used for RIS3 monitoring is not reducible to a closed set. The adoption of a value chain logic for the characterisation and management of specialisation domains implies the analysis of an open catalogue of activities that are undertaken by stakeholders in the process of generating value to be provided to the environment. The dynamics of such activities makes it necessary to reconfigure and reinterpret the information resources used. It is different in the case of monitoring concerning the very element of RIS3 objectives, which are based on relatively unambiguously defined sets of information. In this case, the system can be fed in a predictable way, the information used is finite in scope and can be configured on a one–off, permanent basis. The last element of RIS3 monitoring, i.e. innovation and innovation–related areas, refers on the one hand to specific, established and reproduced data sets, but on the other hand seeks new data sets that clarify or expand the context for regional innovation policy.

For each of the three elements, apart from the natural carriers of monitoring knowledge in the form of categorised, written, titled and publicised data, an equally important body of tacit

[318] More: (UCHWAŁA NR 1213/20 ZARZĄDU WOJEWÓDZTWA MAŁOPOLSKIEGO z dnia 1 września 2020 roku), [Access: 30.09.2020].

knowledge is also identified, which resides, both, within the monitoring unit and its partners, operators and animators of the PPO, intermediate bodies, RPO managing institutions and consultative bodies. This resource is invaluable for the continuity of monitoring activities and the possibility to transfer them to a higher level of excellence, it allows for learning of the units involved and – in terms of institutional memory – organisations. The task of the monitoring system is to capture this resource and transform it into practical, accessible, shared knowledge.

IS monitoring

From the PPO level, the monitoring system is fed with the following (quantitative, qualitative and mixed) information formulas:

- opening report of the tested PPO model – in–depth, multidimensional diagnosis and analysis of each specialisation domain;
- quarterly updated regional knowledge base on smart specialisations – the collection is categorised into at least the following: entrepreneurs, environment institutions, clusters, scientific resources (organisational, infrastructural and qualification), non–scientific qualification resources, potential sources of project financing, existing trans–regional partnerships, scale and trajectories of internationalisation, value chains layout, key scientific and consulting literature. The relationships between the categories are formulated using a dependency diagram;
- BTR–type documents – roadmaps for the preparation and implementation of B+R+I investment feasibility studies within each domain;
- notes from the meetings between the operator and the platform animators with senior management of the regional institutions of key importance to the innovation system – the topics of the meetings will include adjustment of regional solutions for the implementation of projects from the IS areas to the needs of the PPO stakeholders;
- reports of in–depth panel interviews with PPO stakeholders – on challenges for innovation diffusion and digitisation;
- a quarterly technological review in the domain areas – in the form of a newsletter, based on the knowledge and opinions of PPO stakeholders;
- regular notes recommending adjustments to the scope and detailing of the domains – recommendations previously consulted with senior management of regional institutions bearing key importance to the innovation system and discussed at MRI meetings;
- specialisation appendices to RIS3 – an integral part of RIS3, compendia of domain knowledge, subject to regular review;
- executive summaries of subsequent stages (a 2–3 year cycle) of the PPO management – management recommendations for correcting and further running the developed model containing, inter alia, detailed assumptions for the fast track selection of PPO stakeholders' partnership projects.

IS monitoring is also carried out in the form of analyses of the supply of projects submitted in RPO calls for proposals – with particular emphasis on the axis/axes fulfilling Objective I of the Cohesion Policy for 2021–2027. Quantitative reports by a field (the second level of specialisation detail) and by a county (poviat) are compiled quarterly, while an analytical report interpreting trends and relationships is prepared in a 2–year cycle. A tool of the Ministry of Development, Labour and Technology – SmartRadar – is used to monitor the activity and success of the Małopolska Region beneficiaries in the competitions within national operational

programmes, in activities fulfilling the abovementioned Objective I. The conclusions are communicated in the abovementioned report. Conclusions are communicated in the previously mentioned periodic report.

Monitoring of RIS3 objectives

The main objective is described by indicators available in the European Commission's open, periodically updated information resources. The indicators relate to the results and take the form of indices. At the level of strategic objectives (grouped into the areas of interventions), outcome indicators have been used to a large extent[319], although publicly available sources did not always offer data for their measurement. In such cases the information, in a systematic way, is obtained from partner institutions of the monitoring unit (such as KPT, UMWM units – e.g. MORR, recruitment departments of universities, "Business in Małopolska" Centre,). Where justified, the monitoring may take on a qualitative character. In the case of activities referring strongly to specialisation domains and possible to monitor in their order (e.g. internationalisation of activities), knowledge for the needs of domain–specific indicators is obtained from the resources of the PPO.

While measuring the effects of RSI (see Tables 1 and 2), it was decided not to go below the level of the strategic objectives, with the selected indicators covering as exhaustively as possible – at the level of expected results – the wide spectrum of interventions set out by these objectives (naturally, with the large diversity of measures feeding into the objective, finding a universal, perfectly adequate measure was not possible). RIS3 therefore does not identify, analyse or measure objectives at the level of groups of measures and projects. The experience of the RIS3 Management Team shows that the usefulness of information from this level is inadequate to the effort required for its collection and nuanced interpretation. On the other hand, simplification of access to project indicators through the massive data downloading from RPO or KPO system databases leads to duplication of work carried out by managing authorities that report and evaluate performance at the level of each axis. The compilation of intermediate and target values for such measures and their interpretation will take place only within the two planned external evaluations – mid–term and final. Only key projects, singled out by name in RIS3, will be monitored in a qualitative way through annual enforcement of key information (implementation status, material and financial advancement, barriers, perspectives) in a standardised layout directly from the implementers.

Monitoring of innovation

The implementation of one analytical cycle initiated in previous years is continued: determination, using econometric methods, of the impact from smart specialisations of the region on economic development. This study, which provides measurable information value for managing the regional innovation, undergoes minor methodological modifications between successive editions in order to adapt it to the changes in the environment. The analyses will be carried out through outsourcing. At least two editions are planned in the years 2021–2027. In the commissioning model, at least one analysis/study per year is planned concerning the conditions or elements of regional innovation. Topics will be selected ad–hoc, depending on the needs of the monitoring unit or articulated expectations of the Office's partners or PPO stakeholders.

[319] This aspiration has been achieved absolutely for the basic catalogue of indicators (see Table 1) and, with few exceptions, for the additional catalogue of indicators (see Table 2).

In the field of innovation and innovation–related issues an internal knowledge base is built and used for the purpose of monitoring. It consists of scientific studies, consulting literature, strategic and programming documents from the national level and the European Commission, analyses and studies produced within UMWM on innovation–related issues, promotional materials on regional innovation and a number of internal working papers interpreting, developing and decomposing elements of the economic reality which facilitate the management of regional innovation. The database, which is continuously updated, is managed by the Monitoring Unit and serves primarily to improve its analytical activity.

Knowledge management for RIS3 monitoring

Out of the three elements of RIS3 monitoring, only one – monitoring of RIS3 objectives – implies the discipline of setting up target values for indicators and the supervision of their achievement. The remaining ones should be treated rather as sources of knowledge for creating the innovation policy in a way enabling the implementation of the objectives of the Strategy. Despite such a hierarchy, the implementation of IS monitoring requires the largest amount of material resources and appears to be the most labour–intensive (see Figure 3). This distribution of emphasis is not coincidental because, in accordance with the assumptions of the Cohesion Policy for 2021–2027, it is the concept of smart specialisation that most strongly leverages the growth of regional innovation and additionally its monitoring is interwoven as obligatory in the basic conditionality. In this view, the key challenge for the management of RIS3 is to find such tools and formulas for the development of specialisation domains that will simultaneously translate into innovation indicators. It has been addressed, at the strategic level, by defining in the RIS3 document most of the areas of intervention in terms of specialisation.

The knowledge originating from IS monitoring will be reinvested in shaping and supporting the domains – their scope, possibilities to finance projects, tailoring of training offer, networking, internationalisation, supporting international partnerships, commissioning of public tasks. The main addressee and dispenser of multi–format knowledge is ZWM and DZPO, which creates adequate support schemes based on it. Then such solutions are assimilated and implemented by implementing institutions. The use of knowledge from this element of monitoring is also possible for the needs of project implementation under the support schemes available at a given moment and for the needs of intervention outside the stream of EU funds. In this respect, the knowledge from the monitoring may also be used by the above mentioned entities, but also by a number of others, such as the UMWM responsible for eco**n**omy, education, regional policy as well as institutions such as MARR or KPT.

Knowledge gained in the course of monitoring the innovation and innovation–related areas is necessary to build a context for conducting regional innovation policy. The monitoring of this element in previous years provided information about, among others, clusters, start–ups and universities. In the 2021–2027 perspective, due to the inclusion of new stakeholders and animators into the PPO, a greater need for ad–hoc research is expected, owing to which the applicants will want to identify the conditions of their functioning. The recipients of the monitoring knowledge in this area, especially analyses of the impact of specialisations on the regional development, will be primarily the monitoring unit and the entire Department of Ownership Supervision and Economy of UMWM, responsible for the implementation of RIS3. The knowledge will also complement the compendium of studies supporting the region's

development policy at many levels, created by MORR. Contextual, regionally profiled knowledge on innovation–related topics is also an important resource for a number of socio–economic partners of UMWM, such as KPT, development agencies, JST, chambers of industry and commerce, research units, technology transfer centres, scientific units.

Knowledge acquired in the process of monitoring the RIS3 objectives is necessary to grasp the Małopolska Region's advancement in the league of innovative EU regions as well as its absolute progress in this field. At the same time it is the primary element of supervision over the course of the Strategy implementation and making decisions on the corrections in the directions of intervention or scales of the assumed objectives. The recipient of data is the monitoring unit. A catalogue of RIS3 indicators, decomposed to the level of strategic objectives, with assignment of data sources and quantified by expected intermediate and target values, is presented in Tables 1 and 2. The first one includes basic indicators, i.e. with a well–established method of calculation, for which it is possible to provide a baseline value and at the same time the expectation of stability and sustainability within a decade is strongly justified. In the selection of indicators the system of one strategic objective = one indicator was followed, from which two deviations were made; it was anticipated that with a wide variety of activities feeding the objective, striving for a universal, perfectly adequate measure was not justified[320]. The second table includes additional indicators, i.e. measures which inclusion in the monitoring system will be considered after the adoption of the Strategy. These indicators require undertaking or completing ongoing pilot programmes that will allow to determine the possible scope of measurement and to establish baseline values, to carry out consultations with partners who can compile them and to consolidate the procedures for the implementation of projects and programmes implicitly associated with the budgetary perspective 2021–2027. The intention of the monitoring unit is to gradually expand the basic catalogue with verified measures from the additional catalogue.

[320] In fact, such a statement was also reached with regard to several other strategic objectives. In their cases, sticking to one indicator was caused by the lack of access to measures that met the accepted standard of the basic indicator.

Table 1: Basic catalogue of indicators for RIS3 objectives

Main objective	Areas of intervention	Strategic objectives	Indicator	Unit of measurement	Base value	Intermediate value – 2025[321]	Target value – 2030[322]	Source
Increase of the level of innovativeness of the region by 2030			Ranking position in the RII index	Position (excluding UK regions)	144 (2019 edition)	141[323]	**135** [324] (maintained for all RII published[325] in the 2028–2030 editions)	European Commission. Database of the cyclical study "Regional Innovation Scoreboard".
			Share in the value of the RII index for the Warsaw Capital Region	%	89.1 (73.4/82.4) (2019 edition)	90 (2025 edition)	**91,5** (maintained annually for all RII published in the 2028–2030 editions)	European Commission. Database of the cyclical "Regional Innovation Scoreboard" study. (after own calculations).
	Innovative facilities, potential and image of the region	1A. Development of technical infrastructure that supports and stimulates innovative activity	Outlays on innovative activities in enterprises in relation to gross expenditures on fixed assets	% – average of readings over 3 consecutive years[326]	14,07 (2016–2018)	15 (2022–2024)	**18** (2026–2028)	GUS: BDL (after own recalculations)
		1B. To develop the competences for the future within formal education and lifelong learning	Share of graduates from the following sub–groups of majors: arts, business and administration, information and communication technology, engineering and technical as well as medical	% for three–year intervals	45.2 (2017–2019)	46.3 (2023–2025)	**48** (2027–2029)	GUS: BDL (after own recalculations)
			Adults participating in education or training aged 25–64	% – average of readings over 3 consecutive years	5.4 (2016–2018)	6 (2022–2024)	**8** (2026–2028)	GUS: BDL (after own recalculations)

[321] It was assumed that the measurement would be carried out in Q3 2026. It was proposed to base the measurement on editions of reports/datasets which, if the current pace of publication is maintained, should be available then.
[322] It was assumed that the measurement would be carried out in Q1 2031. It was proposed to base the measurement on editions of reports/datasets which, if the current pace of publication is maintained, should be available then.
[323] The RII is published irregularly. If the 2025 edition is not published, it is proposed to include the 2024 reading.
[324] If the authors expand or narrow the catalogue of regions included in the ranking (e.g. as a result of Community enlargement or administrative reforms), the reading should be carried out using the simulated catalogue of the 2019 edition.
[325] RII is published irregularly. Since 2012, it has been published every year or every 2 years. Therefore, in the proposed range of '28–'30, at least 2 RII readings are likely to be possible. However, if only one reading is possible, it is proposed to include the 2027 reading.
[326] The proposals to include more readings into the average are a response to the identified high fluctuation of individual indicators; they allow to stabilise the projected values. This reservation applies to the entire monitoring table.

Main objective	Areas of intervention	Strategic objectives	Indicator	Unit of measurement	Base value	Intermediate value – 2025[321]	Target value – 2030[322]	Source
		1C. Strengthening the brand of the region as a centre of innovation	Share of BIZ in high and medium–high technology manufacturing and service activities[327] (based on the dominant activity of PKD) in the regional volume of BIZ	% for three–year intervals	17.3 (2016–2018)	18 (2022–2024)	**20,5** (2026–2028)	MORR. Database of the periodical study "Foreign investors in the Małopolska Region". (after own calculations)
	Innovation and industrial transformation of enterprises	2A. Strengthening B+R activity of innovative enterprises	Share of employed in B+R in the enterprise sector in total employed in B+R (full–time equivalent)	% for three–year intervals	57.7 (2017–2019)	58.5 (2022–2024)	**62** (2027–2029)	GUS: BDL (after own recalculations)
		2B. Improvement of the technological level and better management of companies	Share of enterprises receiving orders via computer networks	% – average of readings over 3 consecutive years	14.4 (2016–2018)	18 (2022–2024)	**28** (2026–2028)	GUS: BDL (after own recalculations)
		2C. Effective instruments for supporting entrepreneurship and development of enterprise activity	Enquiries from entrepreneurs on foreign expansion handled by the "Business in Małopolska" Centre[328]	Number in measurement year	53 (2020)	100 (2025)	**150** (2030)	CBiM

[327] Assignment of activities to high and medium–high technologies on the basis of the NCBR study: (https://www.ncbr.gov.pl/fileadmin/user_upload/import/tt_content/files/lista_branzy_z_zakresu_wysokich_i_srednio–wysokich_technologii_1.xls), [accessed: 04.01.2021].

[328] The "Business in Małopolska" Centre, financed from the region's budget, has guaranteed financing until 2022. Future values of the indicator are estimated based on the assumption that the undertaking will be continued and on the basis of the entity's long–term experience to date.

	Trust, connection and diffusion of knowledge within the innovation ecosystem (PPO)	3A. Effective management of PPO	Attendance of stakeholders formally included in IS Platforms in strategic workshop meetings[329]	Average % per annum	18,4 [330] (2020)	50 (2025)	**55** (2030)	PPO operator
			The ratio of the share of the value of projects from the Małopolska Region in the total number of projects implemented under Horizon Europe and the share of the number of projects from the Małopolska Region in the total number of projects implemented under Horizon Europe	% for three–year intervals	16,3 [331](13/80) (2014–2020)	25 [332] (2021–2025)	**35** [333] (2021–2030)	European Commission (tool: https://webgate.ec.euRPOa.eu/)
		3B Increased efficiency of public institutions in creating conditions for development of innovation	Number of enterprises supported by CTW underthe SPIN project[334]	Cumulative number	49 (2020)	875 (2020–2025)	**1500** (2020–2030)	Sustainable Development Department, UMWM

[329] "Strategic workshop meeting" is an event category described precisely in the rules for conducting the PPO [accessed 04.01.2021], where it is labelled as activity 2(b).
[330] The baseline is the attendance (ratio of those participating to those formally included) at IS Working Groups meetings. WG is the existing PPO formula that evolved into IS Platforms in late 2020 and early 2021.
[331] The baseline was calculated based on cumulative statistics (as of 18.01.2021) of Horizon 2020.
[332] The intermediate and target value was based on the assumption that the rules for forming consortia and applying to Horizon Europe will be the same as for Horizon 2020. If they are significantly modified, the explanatory value of the indicator will decrease and consideration will have to be given to dropping it.
[333] The cumulative calculation of the indicator means that the projected increase of 10 p.p. between the intermediate reading and the target reading will reflect a significant change (how significant will ultimately depend on the application activity of the Małopolska Region entities in particular years).
[334] The ongoing edition of the SPIN project started in late 2019. The project has guaranteed funding until 2023. Future values of the indicator are estimated based on the assumption that the project will be continued and based on the experience from the implementation of previous editions of the project. As enterprises are not beneficiaries of the project, the indicator is qualified as an outcome measure.

Table 2: Additional catalogue of indicators for RIS3 objectives [335]

Areas of intervention	Strategic objectives	Indicator	Unit of measurement	Comment	Relative expected growth vallue to 2030	Source
Innovative facilities, potential and image of the region	1A. Development of technical infrastructure supporting and stimulating innovative activity	Infrastructural scientific resources in IS domains (knowledge base category of the Małopolska Region PPO)	Indexed value	Baselines and targets will not be possible until mid–2022 at the earliest, once the knowledge base for all domains has been built (a solution for one domain is being piloted until the end of 2021)	Growth for 3+ consecutive, recent years	PPO operator
		Scientific, technical, economic, cultural events	Indexed value (integrating number, scale of events, number of participants, level of innovation, starting from scratch)	Conceptualisation of the indicator possible after the launch of the RPO 2030 and analysis of the product indicators related to the individual measures.	Growth for 3+ consecutive, recent years	DZPO within UMWM (data from the RPO IT system)
		Innovation development processes with a planned use of the LivingLab formula (methodical, deep involvement of target audience) in the public sector	Number	Establishing a baseline requires a pilot study and a partner framework. Scoping in this regard is planned for 2021.	Growth for 3+ consecutive, recent years	Own monitoring – data of the partner (KPT)
	1B. Developing competences for the future in formal education and lifelong education	Share of students in ordered or sponsored courses in the total number of students	%	Establishing a baseline requires a pilot study and a framework for working with partners. Scoping in this regard is planned for 2021. For organisational reasons, the indicator will only include public universities.	+5% maintained for 3+ consecutive years	Own monitoring – partners' data (universities – recruitment departments)
		Relative Earnings Index of graduates from the following sub–groups of majors: arts, business and administration, information and communication technology, engineering and technical as well as medical[336]	% (100%= average earnings in the place of residence)	Establishing a baseline requires expert, manual assignment of directions to subgroups and the assignment of appropriate weights to the directions to create an average indicator. Scoping in this area is planned for 2021.	Growth for 3+ consecutive, recent years	National System for Monitoring the Economic Fate of University Graduates (after own calculation)
	1C. Strengthening the brand of the region as a centre of innovation	Economic events of trans–regional range in IS domains (knowledge base category of the Małopolska Region PPO)	Indexed value	Baselines and targets will not be possible until mid–2022 at the earliest, once the knowledge base for all domains has been built (a solution for one domain is being piloted until the end of 2021)	Growth for 3+ consecutive, recent years	PPO operator
Innovation and industrial transformation of enterprises	2A. Strengthening B+I activity of innovative enterprises 2B. Improvement of the technological level and better	Implementation of B+R results in companies	Number	Conceptualisation of the indicator possible after the launch of the RPO 2030 and analysis of the product indicators related to the individual measures. The validity of the use of the indicator will depend on the line of demarcation between the regional and national levels.	+ 20% for a 3–year average	DZPO within UMWM (data from the RPO information system), possibly the Ministry Development Funds and Regional Policy (data from the national PO system)

[335] Indicators which usefulness for monitoring the objectives of the RSI is recognised, but it is not possible to give their detailed parameters at this stage.
[336] Although the indicator has been – in the result dimension – assigned to strategic objective 1B, in the impact dimension it can also be treated as a hypothetical measure of the entire IO1.

	management of companies	Sources of sureties and capital support for IS entities (subcategory of the knowledge base of the Małopolska Region PPO)	Indexed value	Baselines and targets will not be possible until mid–2022 at the earliest, once the knowledge base for all domains has been built (a solution for one domain is being piloted until the end of 2021).	Growth for 3+ consecutive, recent years	PPO operator
	2C. Effective instruments for supporting entrepreneurship and development of enterprise activity	Share of enterprises using at least one of the technologies listed below: 3D printers works automation means	%	Baseline and target values will be possible to establish subject to the implementation in the programme of public statistics of an experimental study on the degree of adaptation of selected enterprises to the economic requirements of Industry 4.0 [337]	Growth for 3+ consecutive recent years + growth in national share	GUS (may require own calculations)
	2A. Strengthening B+I activity of innovative enterprises	Scale of internationalisation in IS domains (knowledge base category of the Małopolska Region PPO)[338]	Indexed value	Baselines and targets will not be possible until mid–2022 at the earliest, once the knowledge base for all domains has been built (a solution for one domain is being piloted until the end of 2021).	Growth for 3+ consecutive, recent years	PPO operator
Trust, connection and diffusion of knowledge within the innovation ecosystem	3A. Effective management of PPO[339]	—	—	—	—	—
	3B Increased effectiveness of public institutions in creating conditions for the development of innovation	Public contracts awarded through innovation partnerships	Number	As the baseline value is 0, the indicator should be considered as a guardian of qualitative change, meaning adaptation to a new procedural model. In this case, more than specific target values, it is more important to record at least a single case, to analyse the experience and the chances and potentials for its dissemination.	One fully conducted procedure	Own monitoring – partners' data (DG (Business Activity) department within UMWM, ZP team)

[337] If the measurement of the indicator in the proposed (or similar) wording is not realised or its application proves unjustified, the indicator "Number of technologies implemented in enterprises (own results of B+R works or acquired solutions)" will be proposed. It will then be used for strategic objectives 2A and 2B jointly, replacing the currently proposed indicator for objective 2A "Implementation of B+R results in enterprises". A possible conceptualisation of the indicator will be possible after the launch of RPO 2030 and the analysis of product indicators related to individual measures.
[338] If appropriately configured (including joint international projects with public participation, under initiatives such as Interreg or the Vanguard Initiative), the indicator can also be used to monitor strategic objective 3B.
[339] Proposed indicators for this strategic objective are proposed only in Table 1.

9. Management system of RSI WM 2030

The place of the RSI WM 2030 in the management system of regional strategic documents for the years 20+ is not specified at the moment. Clarification should be expected after the Strategy Management Plan to be announced in SRWM 2030. This chapter will be supplemented in the course of updating the RSI WM 2030, after the adoption of the said Plan.

The entity responsible for managing the innovation policy of the region, including through the implementation of RSI WM 2030, is the Board of the Małopolska Region. On its behalf, work on the development of the document and the management of the strategic process assigned to it is performed by the Department of Ownership Supervision and Economy. In the operational dimension, care for the process lies within the competences of the Team for Smart Specialisations Management.

Relevant – in the context of dependencies between these units and other bodies and entities involved in the implementation of RSI (such as MRI, operator and animators of PPO platforms, partner institutions of UMWM and selected departments of the Office) – information is presented in the following places of the Strategy:

- Chapter 1. Regional Innovation Strategy of the Małopolska Region (RSI WM 2030) within the strategic programming system;
- Chapter 2 The affiliations between the RSI WM 2030 and the Development Strategy of the Małopolska Region 2030 2030;
- Chapter 3 Theoretical context regarding the works on the RIS WM 2030 and the main assumptions for the strategy under development; subtitle: Experience regarding the IS and PPO within the Małopolska Region (regional – own perspective);
- Chapter 8: RIS3 monitoring system and running PPO; subchapter: Institutional set–up and decomposition of RIS3 monitoring elements;
- Chapter 9 (current). RSI management system; subchapter: RSI WM 2030 management standards.

RSI WM 2030 Management Standards

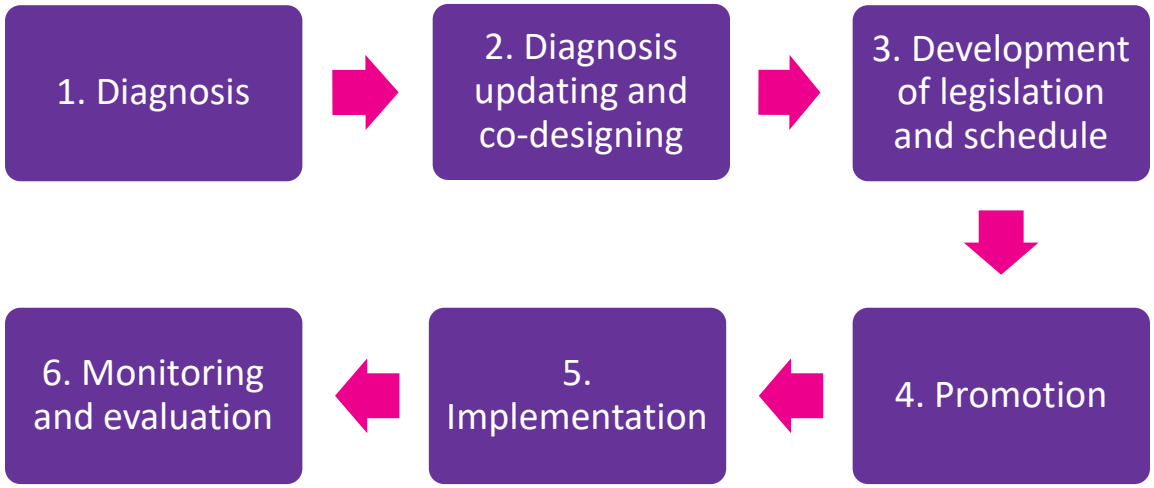
In relation to the theoretical and operational assumptions described in Chapters 3 and 6, related to the design of tools and provision of support within the RSI WM 2030, it is necessary to point to a set of principles that should be consistently applied in this process.

1. A standardised process for preparing support instruments with stakeholder participation.

It should proceed according to the scheme below and take into account the differentiation due to the needs of IS covered by the measure and its sectoral or horizontal nature, as described in Chapter 6. The diagnosis developed for the Strategy should be the starting point, updated on the basis of current information from the PPO and other monitoring instruments, including those conducted by institutions providing support (e.g. statistics of calls for proposals, submitted comments, etc.). The tools – as far as it is possible in terms of organisation and time – should be co–designed with the participation of potential beneficiaries, e.g. on the basis of Service design or Design thinking methodology. The designed support instrument, after legislative preparation and optimisation of its schedule, will be promoted among potential

applicants by means of appropriate communication channels. After its implementation, it will be subject to monitoring and evaluation[340].

Figure 4: The process of designing support instruments in the RSI



2. Basing diagnosis and tool designing on the value chains perspective.

The concept of value chains described in the Strategy in relation to supporting the development of the Małopolska Region IS used at the stage of designing support tools is to contribute to their increased diversity (e.g. in the form of variants or paths within a specific support scheme) corresponding to the needs of the Małopolska Region IS stakeholders. Basic benefits from an application of this principle include:

a) focusing on the actual or expected sources of competitiveness for the Małopolska Regions's economic actors, which should be strengthened,

b) identification of links within IS domains, between IS domains, and within GVCs in which the Małopolska Region entities participate, which may become the basis for innovative cooperation and a source of synergy in activities.

3. Adaptation of instruments to the sectoral or horizontal nature of the intervention

The conducted strategic diagnosis and analysis of the Małopolska Region IS domains indicated a horizontal, cross–sectoral character of some of them (RIS3, RIS4, RIS5, RIS6) and a more "compact", to a greater extent sectoral character of the three of them (RIS1, RIS2, RIS7). This should be reflected in the types of support instruments offered, e.g. by introducing the criteria to stimulate cooperation and linking within value chains, in particular the representatives of horizontal domains. As indicated in Chapter 6, this division also influences the nature of the process related to designing intervention tools: specialisations and horizontal domains require a broad, interdisciplinary discussion and consideration of various points of view, which allows for discovering new possibilities of action, while in the case of sectoral

[340] Monitoring the quality of work of experts evaluating applications for funding is also an important issue, the importance of which was emphasised in the public consultation.

specialisations, what should count above all is the systematically gained experience in supporting them and deepening the knowledge of the needs.

4 Flexibility

This principle concerns, both, openness to periodical changes in the offered set of public aid instruments and evaluation of submitted applications, projects and their settlement. An example of good practice in this case is the partial use of assessment support schemes with the use of a panel of experts having extensive business experience in a given field and the possibility of correcting the application or its "defence" by the applicant before the panel of experts[341]. The dissemination of tools for remote work should foster the more frequent use of such solutions.

5. PPO participants as partners in the tool design process

The specialisation platforms created within the new formula of the PPO, having reached a certain stage of development and maturity, will provide substantive input and premises for the directions of development, assumptions and schedules with regards to support tools offered in the perspective of the year 2030. With high activeness of the platforms, one can also assume direct support from their members when designing tools (e.g. as a stakeholder – potential applicant or animator).

6. Promoting the re–granting formula

An important assumption for the implementation of the Strategy is the continuous involvement of IS and PPO stakeholders, especially entrepreneurs, in the cooperation. As previous European experience shows, this is not guaranteed by the initial activity related to the determination of objectives, areas of intervention and conducting even extensive public consultations[342]. **It is different in the case of designing tools and rules of providing support – conducting this process "close" to entrepreneurs constitutes a motivation for their active participation in the process**. The implementation of such an assumption is facilitated by the use of the regranting formula, i.e. transferring the task of promoting available support and redistribution of funds to institutions with necessary organisational resources and – above all – experience in the field. Such activities may be addressed primarily to IOB and clusters, which meets the intention of stronger inclusion of these institutions in the implementation of public tasks. The use of different variants of regranting and redistribution of support may prove to be crucial from the point of view of the challenge related to striving for greater flexibility and diversity of the support offer. Popularisation of this formula may pose the threats for competitiveness of support, which should be eliminated by maximising transparency of aid transfer.

7. Pursuit of internationalisation

Wherever reasonable and possible, support instruments should encourage, motivate and create opportunities to develop and accumulate contacts, opportunities, experiences and relationships of an international nature.

8. Promoting solutions to social challenges

[341] This concerns, inter alia, the issue of explaining or proving by the applicant the functional connection of the submitted project with the value chain of the area belonging to the domains of the Małopolska Region IS.
[342] Moreover, this is not the role of entrepreneurs – the responsibility for setting regional policy objectives lies with the regional authorities.

In consultation with specialisation platforms, opportunities (diagnosis) and expectations (special competitions, social hackathons, etc.) should be formulated in relation to solving important social problems through technology. Instances of problems could include, for example, environmental issues such as air quality, water quality or noise pollution.

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Annex – TOWS Analysis

<table>
<tr><th colspan="2">Threats</th><th colspan="2">Opportunities</th></tr>
<tr>
<td>Education
Decreasing number of winners of subject competitions and contests
Demography – decreasing number of pupils
Lack of sufficient mechanisms and incentives to ensure high quality of teaching staff
Decrease in the number of new researchers, doctoral graduates
Difficulties with the implementation of distance learning on the part of schools, teachers, parents, students</td>
<td>Entrepreneurship
Difficult and complex succession process facing the Małopolska Region family MŚP
Concentration of economic development in the regional capital (Kraków) and KOM (Kraków Metropolitan Area)
Multinational companies have limited contacts with local MŚP suppliers
Low knowledge of start–ups about BIZ resources in the region, which limits cooperation
Reluctance to cooperate due to lack of trust among entrepreneurs
Reluctance of MŚP owners to take the actions and risks necessary to increase sales of innovative products
The repercussions of the economic crisis caused by the epidemiological situation (lock–down of individual economic sectors, collapse of public finances)</td>
<td>Education
Changing young people's educational preferences (in a technical and vocational direction)
Institutional and research facilities supporting the participation of Polish entities in the largest European B+R funding programme – Horizon 2020
Continuation of strategic support in the field of education while improving the terms and conditions under which it is provided
Existence of business partnerships at universities (such as Comarch Competence Academy at UEK)</td>
<td>Entrepreneurship
High level of entrepreneurship among residents (including starting a business activity),
An increasing number of companies set up in sub–regions with the lowest level of entrepreneurship
Infrastructure potential for the development of Industry 4.0 (in areas such as Internet of Things, Big Data, Artificial Intelligence)
Activity and effectiveness of business/technology incubators at universities
Existing cluster organisations are potential support centres for networking</td>
</tr>
<tr>
<td>Digitalisation
Low rate of opening/accessing public data sets
Digital exclusion of part of the region's population (e.g. elderly people or inhabitants of rural areas and smaller towns)
Inadequate response of enterprises and individual users to risks related to ICT diffusion (e.g. cyber security)</td>
<td>IS
The epidemiological situation related to COVID–19 as a factor slowing down/obstructing the development of some specialisations (this concerns mainly Sustainable energy, leisure industries, chemistry)
Strong dependence of specialisation on external customers for products (strongly export–oriented character with low domestic demand), (this</td>
<td>IS
COVID–19 situation as an opportunity and additional developmental impulse for some of the specialties (mainly Life science, ICT, creative industries)
Fitting specialisation into global consumer trends (this applies above all to creative and leisure industries, Life science, ICT)</td>
<td>Digitalisation
Steady increase in the number of enterprises using ICT tools
Slowly (however seen in reality) growing percentage of companies using Big Data analyses
Activities of Digital Innovation Hub at KPT
Continuation of strategic support in the digitisation domain while</td>
</tr>
</table>

Threats		Opportunities	
• Possible digital competence deficit (including in the education domain) in view of the increasing use of remote working (e.g. due to the prolonged epidemic)	applies mainly to the chemistry, electrical engineering and machine production), • Strong dependence of the sector on global prices and availability of raw materials (this applies mainly to the production of metals, metal products and non–metallic mineral products, chemistry) • Strong dependence on EU legislation influencing the shape and directions of specialisation development (this applies mainly to the production of metals, metal products and non–metallic mineral products, chemistry • Increasing energy prices in Poland – higher than the European average (concerns mainly energy–intensive specialisations such as production of metals, metal products and non–metallic mineral products, chemistry) • High share of foreign capital (possibility of transferring an enterprise or its part from the Małopolska region) (concerns all specialisations – except for creative and leisure industries) • Sector sensitive to negative economic fluctuations (mainly chemistry) • Strong external "price" competition (especially from outside Europe) (this concerns mainly the production of metals, metal products and non–metallic mineral products, Sustainable energy)	• The specialisation fits into the activities related to the so–called European Green Deal (this applies primarily to the production of metals, metal products and non–metallic mineral products, chemistry, electrical engineering and machine industry) • High share of foreign capital (allowing, inter alia, for knowledge diffusion, inclusion in GVCs) (this applies to all specialisations – in particular electrical engineering and machine industry – except for creative and leisure industries) • Linkage to GVCs (mainly ICT, Life science, electrical engineering and machine industry) • Participation of the region in the Vanguard Initiative for New Growth through Smart Specialisation	improving the terms and conditions for its provision

<table>
<tr><th colspan="2">Weaknesses</th><th colspan="2">Strengths</th></tr>
<tr>
<td>Education
Deficits of schools in terms of opportunities for learning key competences (especially digital and entrepreneurial ones – low competences of teachers, poor equipment with ICT tools)
Weak cooperation of vocational education institutions with employers
Insufficient availability and quality of career guidance
Mismatch between education courses and employers' needs (increase in the number of deficit occupations)
Low awareness of the need for and infrequent practice of adult education
Insufficiently developed entrepreneurial culture and skills among students</td>
<td>IS
Low participation of companies from certain specialisations in GVCs (mainly chemistry)
Deficit of skilled workers (also at middle level) (this applies mainly to electrical engineering and machine industry, ICT, Life science)
Lack of precise definition of the nature of specialisation (this applies mainly to electrical engineering and machine industry, ICT, Life science)
Low identification and recognition of specialisations among entrepreneurs representing them (this applies mainly to electrical engineering and machine industry, ICT),
The hitherto perception in strategic documents of the IS concept only through the prism of European funds (RPO), without taking into account the wider social context (e.g. education, lifelong learning, etc.), which remains largely independent of European funds
Lack of experienced trainers and mentors to guide the development of scale–up companies, especially in the biomedical sector</td>
<td>IS
Effective and efficient start–up support ecosystem based on high human capital, availability of project financing, existing organizational structures and research infrastructure (mainly in the ICT sector)
High activity in the area of B+R (mainly Life science, ICT)
Partial support of regional specialisations from the national level (this concerns mainly Life science, chemistry, Sustainable energy, electrical engineering and machine industry)
Presence of experienced IOB in the area of specialisation (mainly Life science, ICT, Sustainable energy)
Diverse catalogue of recipients of the sector's products – this mainly concerns Life science, ICT, electrical engineering and machine industry)
High technological advancement of enterprises in the sector (this applies mainly to Life science, ICT, electrical engineering and machine industry)</td>
<td>Entrepreneurship
Large number and high activity of start–ups (mainly ICT including deep tech)
Relatively high level of foreign trade (imports, exports)
Leading position (both nationwide and globally) in the business services sector, which is represented by various types of centres – BPO, SSC, IT, B+R),
Inclusion into GVCs in key sectors for the region through BIZ
Very high (compared to other regions in Poland) outlays on research and development activity (GERD and BERD indicators), including a high ratio of researchers employed in the business sector
High (in relation to other regions in Poland) share of people employed in high technology sectors, which is dynamically growing
Significant potential for technology transfer / knowledge commercialisation (in terms of institutions, human capital)</td>
</tr>
<tr>
<td>Digitalisation
Low internet speeds
Low level and limited use of internet and digital technologies by companies
Low level of using electronic services of administration by the inhabitants of the region resulting from the lower level of digital competences (in comparison to other regions)</td>
<td>Entrepreneurship
Still small number of stably operating clusters and developing cluster initiatives
Overall, untapped potential of the IOB
Property fragmentation, lack of large investment areas
Low (in relation to the national average) share of employed workers in</td>
<td>Digitalisation
Large number of EU projects implemented in the area of "Information Society"
The image of the region as a strong digital technology centre (including the traditions of Cyfronet at AGH)</td>
<td>Education
Above–average results in external examinations
Relatively high number of students and graduates, including technical and natural science faculties
High (in relation to other regions in Poland) number of invention</td>
</tr>
</table>

Weaknesses		Strengths	
• Shortage of IT specialists, in particular programmers, designers and database administrators • A high proportion of smaller towns that do not have an access to the Internet (in comparison to other regions in Poland)	high and medium–high technology industry • A small number of mechanisms in the region to facilitate cooperation between start–up companies and large, including foreign, companies • Insufficient business management skills among start–ups • Difficulties of MŚP in obtaining external financing		applications submitted in the national and international mode