Catching-up Regions Poland

Supporting Regional Innovation and Entrepreneurship

Lodzkie, Podlaskie and Dolnoslaskie regions

Report Annexes

May 2019
# Table of Contents

**TABLE OF CONTENTS** .......................................................................................................................... 2
**LIST OF FIGURES** ............................................................................................................................... III
**LIST OF TABLES** ................................................................................................................................. III
**LIST OF ACRONYMS** ............................................................................................................................. IV

**APPENDIX 1. ANALYSIS OF THE REGIONAL DEMAND FOR AND SUPPLY OF KNOWLEDGE AND TECHNOLOGY: LODZKIE, PODLASKIE, WALBRZYCH** ................................................................. 5

**APPENDIX 2. CONCEPT NOTES FOR THE REGIONAL PILOTS** ............................................................... 105

2A. PODLASKIE REGION ......................................................................................................................... 105
2C. DOLNOŚLAŃSKIE REGION .................................................................................................................. 124
2B. LODZKIE REGION ............................................................................................................................... 136

**APPENDIX 3. CAPACITY BUILDING** ................................................................................................... 151

3.1 WORKSHOP: RESEARCH COMMERCIALIZATION WORKSHOP FOR UNIVERSITY RESEARCHERS .......... 151
3.2 WORKSHOP: WORKING PRACTICES IN MONITORING THE CAPACITY OF R&D INFRASTRUCTURE .......... 157
3.3 WORKSHOP: DESIGNING REGIONAL INNOVATION AND ENTERPRENEURSHIP POLICY INSTRUMENTS ......... 170

**APPENDIX 4. THE CHALLENGE DRIVEN UNIVERSITY POSSIBLE BENEFITS AND CHALLENGES** .......... 176
List of Figures

Figure 1. Knowledge generation system and knowledge utilization system within the simplified model of Regional Innovation System .............................................. 12
Figure 2 Regional patent portfolio, supply-side in Lodzkie region in 2018 ................................................................. 20
Figure 3. Employment and wages in economic fields in Lodzkie in 2015, compared to Poland ........................................... 28
Figure 4 Changes in employment and wages and salaries in selected economic fields in Lodzkie between 2010 and 2015 ................................................................................. 30
Figure 5. Patent technology fields with a private company applicant in Lodzkie (active patents) ....................................... 34
Figure 6 Network based on co-ownership of patents by Lodzkie stakeholders, 2018 .......................................................... 41
Figure 7 Regional patent portfolio, supply side in Podlaskie region in 2018 ................................................................. 47
Figure 8. Employment and wages in economic fields in Podlaskie in 2015, compared to Poland ........................................... 52
Figure 9. Changes in employment and wages and salaries in selected economic fields in Podlaskie between 2010 and 2015 ................................................................................. 53
Figure 10. Patent technology fields with a private company applicant in Podlaskie (active patents) ................................. 57
Figure 11. Network based on co-ownership of patents by Podlaskie stakeholders, 2018 .......................................................... 61
Figure 12. Regional patent portfolio, supply side in Lower Silesia region in 2018 ............................................................. 67
Figure 13 Patent portfolio of the demand-side in Walbrzych sub-region (active patents) ...................................................... 71
Figure 14. Structured list of emerging practical recommendations .................................................................................. 76
Figure 15. Intramural R&D expenditures (GERD) by NUTS 2 regions, in % of GDP ......................................................... 82
Figure 16. Employment in R&D by economic sectors, 2015, regional comparison ........................................................... 83
Figure 17. Granted patents by NUTS 2 regions in 2017 (in %, normalized by population) .................................................. 83

List of Tables

Table 1. Gaps and overlaps between demand-side and supply-side.............................................................................. 14
Table 2. Structural, regional, and aspirational peers ........................................................................................................ 15
Table 3. Economic and R&D characteristics in Lodzkie and peer regions in 2016 ............................................................ 18
Table 4. List of key supply-side stakeholders in Lodzkie region, active patents ............................................................ 22
Table 5. Top 10 R&D institution participations in 7th Framework Program and Horizon 2020 (years 2007-2018) ............. 23
Table 6. Ten fastest growing manufacturing fields according to revenues in Lodzkie by NACE ................................. 31
Table 7. The companies with the biggest revenues in Lodzkie in 2017/2016 ............................................................... 32
Table 8. Top patent applicants by companies in Lodzkie in 2018 ................................................................................. 34
Table 9. Gaps and overlaps between demand and supply-side in Lodzkie .................................................................... 36
Table 10. Economic and R&D characteristics in Podlaskie and peer regions in 2016 ..................................................... 44
Table 11. List of key supply-side stakeholders in Podlaskie region, active patents .......................................................... 48
Table 12. Top 15 largest economic fields according to revenues in Podlaskie by NACE .................................................. 54
Table 13. Top patent applicants by companies in Podlaskie in 2018 ............................................................................. 56
Table 14. Gaps and overlaps between demand and supply-side in Podlaskie ..................................................................... 59
Table 15. Economic and R&D characteristics in Lower Silesia and peer regions in 2016 .................................................. 64
Table 16. List of key supply-side stakeholders in the Lower Silesia region, active patents ............................................. 67
Table 17. Top 15 largest economic fields according to revenues in Walbrzych sub-region by NACE .............................. 69
Table 18. The companies with the biggest revenues in Walbrzych region in 2017/2016 .................................................... 70
Table 19. Gaps and overlaps between demand and supply-side in Walbrzych sub-region ............................................. 73
Table 20. Average monthly gross wages and salaries in regional peers in relation to the Polish mean (Poland = 100) between 2008 and 2017 ............................................................................. 82
Table 21. Unemployment rate by selected NUTS 2 regions between 2008 and 2017 (Lodzkie) ........................................ 83
Table 22. Companies with highest growths in Lodzkie in 2018 ...................................................................................... 84
Table 23. Demand-side participations in Horizon 2020 and FP7 by application projects and topic (years 2008-2018) .......... 85
Table 24. Unemployment rate by selected NUTS 2 regions between 2008 and 2017 (Podlaskie) ..................................... 86
Table 25. The companies with biggest revenues in Podlaskie in 2017/2016 ................................................................. 86
Table 26. Ten fastest growing manufacturing fields according to revenues in Podlaskie by NACE .................87
Table 27. Lower Silesia unemployment rates by NUTS 2 regions (%) .................................................................88
Table 28. Supply side participations in Horizon 2020 and FP7 by application projects and topic (years 2008-2018) ................................................................................................................................................88
Table 29. Ten fastest growing manufacturing fields according to revenues in Wałbrzych sub-region by NACE ..89
Table 30. Companies with highest growths in Wałbrzych region in 2017/2016 ......................................................89
Table 31. Top patent applicants by companies in Wałbrzych sub-region in 2018 .....................................................90
Table 32. I&E ecosystem stakeholders in three Polish regions .................................................................................91
Table 33. List of interviewed stakeholders in the three Polish regions .................................................................96
Table 34. List of national and regional instruments in the three Polish Regions ....................................................97

List of acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Full Form</th>
</tr>
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<tbody>
<tr>
<td>BLC</td>
<td>Business Led Challenge</td>
</tr>
<tr>
<td>BMU</td>
<td>Bialystok Medical University (Podlaskie)</td>
</tr>
<tr>
<td>BU</td>
<td>Bialystok University (Podlaskie)</td>
</tr>
<tr>
<td>BUT</td>
<td>Bialystok University of Technology (Podlaskie)</td>
</tr>
<tr>
<td>CDU</td>
<td>Challenge Driven University</td>
</tr>
<tr>
<td>CBI</td>
<td>Center for Business Innovation</td>
</tr>
<tr>
<td>CTT</td>
<td>Center of Technology Transfer</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
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<tr>
<td>EPO</td>
<td>European Patent Office</td>
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<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>HEI</td>
<td>Higher Education Institution</td>
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<tr>
<td>IP</td>
<td>Intellectual Property (Rights)</td>
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<tr>
<td>LMU</td>
<td>Lodz Medical University (Lodzkie)</td>
</tr>
<tr>
<td>LU</td>
<td>Lodz University (Lodzkie)</td>
</tr>
<tr>
<td>LUT</td>
<td>Lodz University of Technology (Lodzkie)</td>
</tr>
<tr>
<td>MA</td>
<td>Managing Authority</td>
</tr>
<tr>
<td>MS</td>
<td>Member State</td>
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<tr>
<td>MO</td>
<td>Marshal Office</td>
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<tr>
<td>NSF</td>
<td>National Science Foundation</td>
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<tr>
<td>PoC</td>
<td>Proof of Concept</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<tr>
<td>RIS3</td>
<td>Regional Innovation Strategies</td>
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<tr>
<td>ROP</td>
<td>Regional Operational Program</td>
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<tr>
<td>SME</td>
<td>Small and Medium-Sized Enterprises</td>
</tr>
<tr>
<td>SPC</td>
<td>Special Purpose Company</td>
</tr>
<tr>
<td>STEM</td>
<td>Science Technology Engineering and Mathematics</td>
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<tr>
<td>TA</td>
<td>Technical Assistance</td>
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<tr>
<td>TAIEX</td>
<td>Technical Assistance and Information Exchange</td>
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<tr>
<td>TTO</td>
<td>Technology Transfer Office</td>
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<tr>
<td>WB</td>
<td>World Bank</td>
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<tr>
<td>WUT</td>
<td>Wroclaw University of Technology (Dolnoslaskie)</td>
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The following document is a set of four annexes to the main report on the WB engagement under Catching-up Regions Poland Initiative – Supporting Regional Innovation and Entrepreneurship. This Annex to the main report contains detailed key outputs, specifically the underlying analytical report that allowed to design three pilot programs for the regions, the concept notes for the designed pilots per region, and the descriptions of a number of capacity building activities delivered by the team.

Appendix 1. Analysis of the regional demand for and supply of knowledge and technology: Lodzkie, Podlaskie, Walbrzych

INTRODUCTION

EU cohesion policy is designed to reduce disparities between Member states and regions across the European Union. However, some European regions have struggled to catch-up to wider EU growth. Hence, the EU has implemented the Lagging Regions Initiative. The goal of the initiative is to identify the problems of the lagging regions and design and implement actions unlocking their growth potential. Poland and Romania were the first two countries, where the initiative was piloted. The Polish part of the Lagging Regions Initiative was named “Catching-up Regions Poland” and was implemented in Swietokrzyskie and Podkarpackie. The World Bank provided technical assistance (TA) and helped to coordinate activities in these regions.

The Catching-up Regions Poland continues in another three regions, Lodzkie, Podlaskie, and Walbrzych sub-region in Lower Silesia. This report is one of the outcomes of this initiative carefully analysing the situation in these regions and identifying the potential for growth. One of the biggest opportunities to stimulate growth is to enhance the technology transfer from universities and research institutes and support local companies in the adoption of innovations. Thus, technology transfer is central to this report. In lagging regions, technology transfer can be one of the key drivers of regional competitiveness and regional growth\(^1\) and can play an important role in economic development in general. However, technology transfer is often rather weak in lagging regions compared to regional leaders.

After a detailed examination of the situation in Lodzkie, Podlaskie, and Walbrzych regions, the report proposes practical recommendations that will lead to improved technology transfer capabilities, innovation adoption, and economic growth of the analysed regions. Technology transfer in the context of this report is understood in its broader definition as a transfer of intellectual property (both formal and informal) from universities and research institutes in to practice, university-based entrepreneurship, contractual research, and other types of cooperation between academia and private companies\(^2\).

\(^2\) Wahab et al., 2012
The main body of the report has three parts according to the three studied regions. The report starts with a conceptual framework where the general approach is formulated, and terminology is defined. Then the methodology and data sources are explained. Within each regional part, the structure follows the conceptual framework and the two main components: the demand-side (represented by private companies) and the supply-side (represented by universities and research institutes). Based on the findings in these two chapters, gaps and overlaps between the demand-side and the supply-side are discussed. The gaps and overlaps are then related to existing Regional Innovation Strategies (RIS3) of the regions. The report concludes with practical recommendations and possible directions for future interventions.
Executive Summary

Lodzkie Voivodship executive summary

The Regional Innovation Strategy of Lodzkie identifies technology transfer as a less developed component that needs to be addressed. In the Polish and European context, the Lodzkie region is doing relatively well in economics; on the other hand, the R&D characteristics have been stagnating. Although the overall trend is positive, Lodzkie is still rather distant from its aspirational peers.

The Lodzkie region has a strong legacy in textile and textile-related fields. Within textile, there is a particular sub-field, which is relatively well represented in both demand-side (businesses) and supply-side (academia), nano-materials and nano-technologies. The nano-material, specifically non-woven textile, also builds on the textile industry related value chains (including automotive, which is very strong in the region, with high demand for non-woven textile). There is a specific research institute devoted to textile – Textile Research Institute. The textile technology field is one of the strongest fields in Lodz University of Technology as well. In this field, there is a big potential for start-up and spin-off creation mainly thanks to the existing value chain and strong potential in academia. Moreover, there is a relatively strong wearing apparel business, which needs to be innovated.

The pharmaceutical field shows strengths on both demand and supply-side. There are several large businesses in the region (Pelion, Hurtap, Lek, PGP). Pharmaceuticals is also one of the key competencies at the University of Lodz. Both in the private sector and at universities, there is a high share of patents in the pharmaceutical field. There is also a medical university (Medical University of Lodz), which is ranked as the best university/research institute in the region and has a strong competence in pharmaceuticals. However, cooperation between the demand-side and the supply-side is weak in this field. The reason mentioned the most often by interviewed stakeholders is that pharmaceutical business innovates predominantly in-house.

The closely related fields of medical technology and biotechnology are very strong on the side of universities, but private companies do not utilize this expertise. This can be considered as an opportunity for companies even though there are not that many stakeholders in this domain in the region. These fields are especially strong at the University of Lodz and the Medical University of Lodz. The supply-side expertise is supported by a specific local supporting infrastructure, the BioNanoPark. However, a number of stakeholders from the region mentioned that BioNanoPark has not still utilized its full potential.

The manufacture of electrical equipment has a high potential for technology transfer. There is relatively high employment in this sector and, compared to the Polish average in this field, significantly higher wages. The automotive-related value chain and the strong presence of relevant business players in the region (Borg Automotive, Wielton) creates an opportunity for universities and research institutes, especially the Technical University in Lodz, to commercialize their expertise. The Technical
University in Lodz can build on existing strategic cooperation with Wielton they declared in the online survey.

**Lodzkie’s regional innovation system represents a “locked-in” region, region with a historical specialization that has been struggling to keep up with the technological and innovation trends.** Lodzkie can be considered as a fragmented region as well; there is a metropolitan area with highly specialized research domains yet with rather low cooperation between relevant actors. Importantly, the information about the supply of the expertise with innovation potential as well as the demand for this expertise is missing.

The cooperation between companies and universities is weak even though there is a strong potential. The key stakeholders consider the motivation for cooperation on both sides as the biggest barrier. Companies often seek expertise outside the regions or try to innovate in-house without any cooperation with universities and research institutes. However, there is a willingness to cooperate on both sides, but both companies and universities have different priorities, and it is difficult to find a common language. There is a demand especially for specific expertise, yet mainly for routine measurements and analyses that are not that interesting for researchers (none or limited scientific added value). Thus, a potential for cooperation with bigger added value should be encouraged.

**Podlaskie Voivodship executive summary**

The Podlaskie Voivodship has a slight potential of research and insufficiently developed scientific cooperation with other units in the R&D area in the country and abroad. In the Regional Innovation Strategy, weak cooperation between knowledge generation and knowledge utilization subsystem is mentioned as one of the most important weaknesses. This underdeveloped cooperation is connected to weak links between formal education and practical education (including universities). Regarding the technology transfer, a present low effectiveness of Centers of Technology Transfer is mentioned. Economically, the Regional Innovation Strategy mentions low R&D investments and insufficient internationalization of the demand-side.

**Medical technology is a field with a quite high potential for successful cooperation between businesses and academia.** The economic power of this sector is not as big as the food-related sector, but it is very innovative and growing. There are several important private stakeholders in this field. Companies in this field are very active in patenting, thus aware of the necessity to innovate. Medical technology is one of the strongest fields in the supply-side, representing 14% of all supply-side patents in Podlaskie. The leaders behind the medical technology are Bialystok University of Technology and Medical University Bialystok. The potential for cooperation between the demand-side and the supply-side is high and should be capitalized on. However, one of the business leaders in this field from the

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3 Skibicka-Sokolowska, 2013

4 This is notable as Podlaskie is considered as a gate to the East, with quite strong links to Russia and Belarus. Additionally, due to geopolitical situation and restrictions in trading goods in recent years, these links have weakened.
The region mentioned that cooperation with local universities is complicated and that they prefer cooperation with universities from other regions and abroad instead.

The region has a very strong agricultural sector, dairy products production in particular (capturing 18% of the regional turnover). However, the food production sector as the strongest sector in Podlaskie is not matched by the expertise at universities and research institutes. The sector is innovating as the R&D investments figures show. However, they are not very interested in cooperation with universities, as interviews with relevant stakeholders showed. Still, there is some potential for the supply-side (University in Bialystok in particular, partly the Medical University) to cater for the demand-side and for the sector to capitalize on its market position and innovate. The potential does not have to be in direct cooperation between businesses and universities; there is also a potential for academic start-ups and spin-offs, which might fit well into the existing value chains in the food-related sectors.

Another field with technology transfer potential is Manufacture of machinery and equipment, especially the manufacture of agricultural and forestry machines. This field is a strong employer in the region and creates a critical mass (employees, skills, value chains) necessary for successful technology transfer. There are several strong companies in the region complemented by strong clusters (such as the Metal Processing Cluster). Companies in this field are quite active in patenting. However, the demand-side activity in these fields is not matched by the supply-side even though the Bialystok University of Technology has a potential for possible cooperation.

The Pharmaceuticals sector, on the other hand, is represented by strong expertise at universities, while there is very low activity in this field in the private sector. The key stakeholders in this field are mainly the Medical University Bialystok, followed by the Bialystok University of Technology. This expertise is specific due to higher than average patenting activity. Moreover, approximately 20% of the active patents are international, and there is some cooperation with institutions from other regions and from abroad.

The cooperation between the businesses and public research organizations is weak, even though there is a potential in some economic fields. Beside traditional cooperation between the demand-side and the supply-side, there are possibilities for start-up and spin-off creation. However, the support infrastructure (local innovation asset) is insufficient, including the role of centres of technology transfer. Compared to Lodzkie, the level of cooperation between the demand-side and the supply-side is even weaker. The reason is the limited offer at universities and research institutes (with the possible exception of the Technical University in Bialystok) and very low level of mutual trust. Trust building activities, networking, and good practice examples are needed. Moreover, the information is very limited – companies do not know what universities offer, and universities do not have much knowledge about the needs of the private sector. In addition, most of the interviewed companies cooperating with universities mentioned problems with timely delivery and low cost-effectiveness compared to business-business cooperation. All the problems mentioned are related to the fact that the excellent talent is often leaving the region. This “brain drain” is typical for peripheral regions such as Podlaskie.
Interviewed companies, when interested in university-business cooperation, often seek routine measurements and analyses, not strategic cooperation with innovation potential. There is often a mismatch between the expectations of companies and universities. Universities would prefer long-term cooperation with more research-oriented tasks, while companies seek measurements and specialized tests (often with an emphasis on a quick delivery\(^5\)), usually not having the equipment available. Increased use of research equipment is surely desirable (such as the ancillary use of 20% of available R&D equipment capacity), but it should not be limited to routine tasks; this is not very attractive for researchers. It is strongly connected with the present academic incentive system in Poland, favoring academic publications over application results.

The cooperation between the demand-side and the supply-side is complicated also by the fact that companies often do not value long-term innovation, where the supply-side might be most useful. Even though there are exceptions (such as ChM), the innovativeness of companies in Podlaskie is limited. The interviewed companies innovate incrementally and do not work on more disruptive innovations\(^6\). The companies often lack best practice examples (and perhaps, even more importantly, bad practice examples), which would help them to understand the importance of innovations as such.

Regarding the imperfections of the regional innovation system, Podlaskie represents a combination of an “organizationally thin” and partly a “locked-in” region. Podlaskie is an agricultural region, and the capacity of the demand-side is limited. Similarly, there are not many notable supply-side stakeholders, and academic expertise must be often looked for outside the region (see the network analysis for example). On the other hand, some sectors are very strong (food sector) but not capable of keeping up with the innovations and trends. Thus, one can consider Podlaskie as a locked-in region as well.

Walbrzych sub-region executive summary

The Walbrzych sub-region is a peripheral sub-region within a relatively well-developed Lower Silesia Voivodship. Lower Silesia is considered a Moderate – Innovator with increasing innovation performance over time. There is not much data on innovativeness for Walbrzych sub-region as such, but from the interviews as well as from the data, it is clear that the region is underperforming. Due to the peripheral location, there is a significantly higher unemployment rate than in the Lower Silesia on average and significantly higher than the national average, although the unemployment rate has been decreasing. The even bigger problem for the innovation potential is still very low R&D expenditures, even though the figures have been slightly increasing in the last few years. Even though there are not many supply-side stakeholders in Walbrzych region, there are strong universities and research institutes not far away in Wroclaw.

\(^5\) Moreover, the laboratories are often not accredited, which complicates cooperation with companies.

\(^6\) See so called innovation horizons (https://blog.hypeinnovation.com/using-the-three-horizons-framework-for-innovation): the majority of companies in Podlaskie think only about horizon 1, to some extent about horizon 2, almost completely ignoring possibilities of the horizon 3
The automotive industry and other transport manufacturing emerge as dominate dominant players in the region’s private sector. The automotive sector attracts FDI into the region, Toyota company being an example. However, the automotive sector is not very well integrated into the local value chain and production network. Even though this is mainly due to the position of Poland in a global economy, there is still a potential for upgrading and possibly for start-ups delivering for bigger players. While the link between automotive and other businesses is rather low, there is almost non-existent cooperation between automotive and universities or other knowledge-generation stakeholders. Wagony Swidnica represents other transport manufacturing sector; they manufacture railway locomotive and rolling stock. Even though Wagony Swidnica has the global R&D centre in Walbrzych, the cooperation with universities is weak and limited to routine measurements and analysis utilizing the unique equipment.

The chemistry industry emerges as a field with the highest potential for collaboration between universities and local private firms due to the significant overlap between specializations of these two sub-systems. It is by far the most common technology field in patenting, and the share in the patent portfolio is significantly higher than in Poland on average. Moreover, the publication of excellent papers in this field is higher than elsewhere in Poland. There are several big private players as well. Despite the overlap of the specializations, there is very little cooperation between these two subsystems.

The majority of cooperation mentioned during the interviews is using university specific equipment by private companies. This type of cooperation is quite common. There were very few examples of more complex research tasks. The evidence of the available equipment, as well as relevant contacts, are still missing though. Moreover, the majority of cooperation is based on personal contacts at universities (only company Selena mentioned sporadic research cooperation with a university).

The innovation potential of the selected firms interviewed in Walbrzych region is relatively high, and all interviewed companies invest significantly into R&D. The data on R&D investments supports this outcome. There are several excellent companies with strong innovation potential in the region. They actively seek partners for their R&D, but mostly among private partners and clients, the potential of the supply-side is, in their view, limited. Joint activities, networking, or joint projects would probably help to build some trust and enhance cooperation. The innovation voucher scheme is an interesting possibility (offered by T-park, for example). However, even though the majority of companies are interested in this concept, none of the interviewed companies knew about this particular scheme.

Regarding the imperfections of the regional innovation system, Walbrzych sub-region is a typical “organizationally thin” region. The supply-side in the region is very limited, even though the high-quality universities and research institutes are only 30 kilometres from Walbrzych, in Wroclaw. On the other hand, there are some excellent and innovative companies, which seek partnerships. However, they have not found a common language with universities yet, using their unique equipment being an
only exception. In some cases, companies also seek for new know-how (especially in chemistry) at the university, but the cooperation has mainly the form of consultancy, both formal and informal.

**Conceptual framework**

The report adopts the concept of the Regional Innovation System\(^7\) as an analytical tool, distinguishing between the knowledge generation sub-system and knowledge utilization sub-system. The knowledge generation subsystem is understood as a supply-side\(^8\), and the knowledge utilization subsystem as a demand-side. Besides the supply side and the demand side, there is a local innovation asset as an intermediary. The Regional Innovation System is pictured in Figure 1. The Regional Innovation System is influenced by factors external to the region as well. Similarly, the university-business cooperation does not happen solely between the companies and universities within the region; there are links across the regional borders. The model of Regional Innovation System is shown below.

*Figure 1. Knowledge generation system and knowledge utilization system within the simplified model of Regional Innovation System*

![Regional Innovation System Diagram](source: based on Cooke and Piccaluga, 2004, adjusted)

The sizes of the knowledge generation and knowledge utilization subsystem vary greatly. In regions that build their competitiveness on innovation, the subsystem of knowledge utilisation is usually bigger, or both systems are of a similar size\(^9\). These regions also achieve higher economic maturity. By

\(^7\) Cooke and Piccaluga, 2004; Cooke and Leydesdorff 2006

\(^8\) Connected with the so called third role of universities

\(^9\) Blažek and Kadlec 2018
contrast, lagging regions have a more developed knowledge generation subsystem. In these regions, the R&D employment and R&D spending figures are usually connected with universities and research institutes. The sizes of these subsystems thus directly affect the potential of technology transfer for competitiveness and growth of the region.

The interconnection of both subsystems is important, yet often far from perfect. In practice, three basic types of imperfect regional innovation systems can be defined (often it is a combination of more types)\(^\text{10}\):

- "organizationally thin," where there are not enough actors capable of innovation, which is typical for rural areas;
- "locked-in," where industrial regions are not able to keep up with technological and innovation trends and accumulate knowledge and institutions\(^\text{11}\) with rather low competitiveness;
- "fragmented" when there are enough actors able to innovate in the region, but they are not interconnected.

There are both gaps and overlaps of the specific expertise of the demand side and the supply side. There are several types of gaps and two types of overlaps (see Table 1). The gap is a situation when regional specialization of the demand-side does not match the specialization of the supply-side.

There are three types of gaps:

1. **Regional gap:** regional specializations, which can be found neither in the supply nor in the demand-side. There is minimal potential for technology transfer in these specializations, and it is not relevant for this report.
2. **Supply-side gap:** regional specializations, which can be found in the demand-side, but is underrepresented or missing in the supply-side. This gap represents an opportunity for the supply-side, which can provide better for the demand-side.
3. **Demand-side gap:** regional specializations, which can be found in the supply-side, but is underrepresented in the demand-side. This gap represents an opportunity for the demand-side, which can be utilized better the expertise of the supply-side.

The overlaps might be of two types:

4. **Overlap without cooperation:** where there is a similar specialization of the demand and the supply-side, but weak cooperation between the two subsystems, usually because of different positions in a production and research networks. This overlap represents an opportunity with high potential for technology transfer.
5. **Overlap with cooperation:** horizontal overlap matched by strong cooperation in those fields between the supply-side and the demand-side. This overlap represents a specific regional

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\(^{10}\) Tödtling and Trippi 2005; most regions suffer to a certain extent from all kinds of these imperfections

\(^{11}\) Not only physical institutions, but also a set of both formal and informal social patterns (see, for example, Anthony Giddens’ work)
specialization with functioning technology transfer leading to innovation. This overlap might be supported in strategic interventions with a goal of further strengthening of the existing strengths.

Table 1. Gaps and overlaps between demand-side and supply-side

<table>
<thead>
<tr>
<th>not significant in the demand-side</th>
<th>significant in the demand-side</th>
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<tbody>
<tr>
<td>1 Regional GAP (no potential)</td>
<td>2 Supply-side GAP (potential for the supply-side)</td>
</tr>
<tr>
<td>3 Demand-side GAP (potential for the demand-side)</td>
<td>4 OVERLAP without cooperation</td>
</tr>
<tr>
<td>5 OVERLAP with cooperation (the biggest potential for technology transfer)</td>
<td></td>
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</table>

Source: own scheme, based on Cooke and Piccaluga 2004
Methodology and limitations

The analysis combines quantitative and qualitative methods\(^\text{12}\). This approach helps to identify both general regularities and patterns (extensive quantitative analysis) as well as specific causal explanations (intensive qualitative analysis). The analysis is focusing on technology transfer and its potential to increase regional competitiveness through innovation. The quantitative part helps to understand the levels of regional economic development and technology transfer potential both from the demand-side and supply-side perspective. In the qualitative part, the patterns uncovered in the quantitative part are further studied and possible explanations discussed. This is achieved through semi-structured interviews with the key regional stakeholders.

The analysis focuses on three specific regions, Lodzkie, Podlaskie, and Walbrzych in Lower Silesia. It is both economically and culturally (historically) very heterogeneous group of regions. Thus, there are no common chapters, and each regional chapter is standalone. The common features, as well as regional specifics, are included in the final section – Practical recommendations.

For benchmarking, several types of peer regions are used – structural peers, regional peers, and aspirational peers. The structural peers are lagging (low income) regions throughout the European Union with similar GDP per capita as studied regions. The structural peers are the same for all studied regions. The regional peers are geographically close regions, i.e., the neighbouring regions. The aspirational regions are regions with similar structures as studied regions but they are more developed\(^\text{13}\). These regions represent a model of how the studied regions might develop. All regions selected for benchmarking are pictured in Table 2.

Table 2. Structural, regional, and aspirational peers

<table>
<thead>
<tr>
<th>Peers</th>
<th>Regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural peers</td>
<td>All regions: Nord-Vest (RO), Sud-Est (RO), Dél-Alföld (HU), Sud - Muntenia (RO), Észak-Magyarország (HU)</td>
</tr>
<tr>
<td>Regional peers</td>
<td>Lodzkie: Mazowieckie (PL), Swietokrzyskie (PL), Slaskie (PL), Wielkopolskie (PL)</td>
</tr>
<tr>
<td></td>
<td>Podlaskie: Warminsko-Mazurske (PL), Mazowieckie (PL), Lower Silesia: Lubuskie (PL), Wielkopolskie (PL), Opolskie (PL)</td>
</tr>
<tr>
<td>Aspirational peers</td>
<td>Lodzkie: Jihovýchod (CZ), Midi-Pyrénées (FR)</td>
</tr>
<tr>
<td></td>
<td>Podlaskie: Limousin (FR). Niederbayern (DE)</td>
</tr>
<tr>
<td>Lower Silesia</td>
<td>Jihovýchod (CZ), Midi-Pyrénées (FR)</td>
</tr>
</tbody>
</table>

Source: own selection, for an explanation of respective types of peers see the text, for selection of structural peers, see http://tools.orkestra.deusto.es/s3platform/benchmark/

In the quantitative part of the analysis, the report employs secondary data. First, it is aggregated statistics from Eurostat and Polish statistical office, and microdata from specialized databases. These databases include freely accessible data from European Patent Office (Espacenet\(^\text{14}\)) or data on

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\(^{12}\) Sometimes referred to as “mixed methods” (Johnson and Onwuegbuzie, 2004)

\(^{13}\) For more details for selection of structural peers see http://tools.orkestra.deusto.es/s3platform/benchmark/

\(^{14}\) [https://worldwide.espacenet.com](https://worldwide.espacenet.com)
European community projects (Cordis15) as well as data from professional databases such as Amadeus (run by Bureau van Dijk, Moodys16) with economic data or Orbit17 with patent data. Combination of these data sources enables one to perform a very detailed analysis. At the same, the combination of aggregated data and microdata guarantee higher reliability of the presented results. While in the benchmarking section only overall regional figures were considered, in the subsequent supply-side and demand-side sections, the figures were studied in detail including micro-data.

The network analysis improves understanding of bilateral and multilateral relations between supply-side and demand-side stakeholders. While the descriptive statistics can uncover interesting facts about the region and its stakeholders, it does not say much about the relationship between these stakeholders. The network analysis is based on patent co-ownership both within and outside the region18. It visualizes the network of cooperating institutions. Thus, it helps to identify the key stakeholders (nodes in the network) and, importantly, the key relationships (edges in the network). Furthermore, it helps to assess the level of self-containment of the region. Thus, it partly overcomes the problem with a limited number of data about supply-side and demand-side relations outside the region.

The secondary data are complemented by primary data directly from selected stakeholders gathered through interviews. Altogether, 25 semi-structured interviews were undertaken (5 in Walbrzych, 10 in Podlaskie, 10 in Lodzkie). The selection of stakeholders for interviews was based on several criteria. First, the economic power was taken into account (turnover, growth rate). Second, the activity in intellectual property protection was considered (number of patents). Other criteria included participation in innovation projects (European Commission Framework Programs such as Horizon2020), start-up and young companies with venture capital (VC) funding, and companies participating in innovation competitions. The interviews helped to interpret the quantitative results and uncover causalities. Moreover, some examples are presented in the form of case studies throughout the text. The main goal of the interviews was to identify the level of vertical overlaps (existing cooperation in regional specializations), the role of the stakeholder within the regional innovation system, barriers for technology transfer, and examples of best practice. It helped to complete the picture of technology transfer in all three regions. The data gathered through interviews were complemented by studying the relevant policy documents, web pages of stakeholders and other relevant sources.

Universities took part in an online survey, which complemented the qualitative analysis on the supply-side. The survey focused on technology transfer outputs and capacity, existing strategic cooperation with companies (including contractual research) and future capacity building and other

16 Amadeus contains comprehensive information on companies across Europe. Especially, focusing on financial indicators.
17 https://www.orbit.com
18 For methodology see Hidalgo et al., 2007; due to rather complicated methodology, the detailed methodology is not presented. Due to limited number of joint patents, a network analysis in Walbrzych sub-region could not be constructed.
needs of CTTs at respective universities. Some part of the survey is confidential and is not included in this analysis. The survey was completed by the Lodz University of Technology, University of Lodz, Medical University of Lodz, Bialystok University of Technology, and Medical University of Bialystok.

It is important to highlight some of the limitations of this research related to the limited availability of technology transfer indicators. One of the limitations is data on the cooperation between the supply-side and the demand-side in the form of contractual research. Since the public research organizations do not report contractual research in a standardized way, it could not be used in the analyses. On the demand side, there are not many data on other forms of cooperation with the supply-side such as industry-led diploma theses, internships, etc. Importantly, as the cooperation between stakeholders outside the region was not captured in the quantitative part, the missing links to other regions might have been missed (if not uncovered during interviews or the network analysis). The qualitative part is limited by the number of interviews undertaken and the response rate of the selected companies.
Lodzkie Region

Benchmarking Lodzkie

The Regional Innovation Scoreboard\(^2\) places Lodzkie as a moderate - innovator but with increasing performance over time; the relative strengths are in non-R&D innovation expenditures and design applications, the relative weaknesses in marketing/organizational innovations, EPO patent applications, and SMEs innovating in-house. Similarly, the Regional Innovation Strategy\(^3\) considers Lodzkie as a weak innovator but with progressive innovation growth. The economic (GDP and unemployment) and R&D (employment and shares of different sectors) regional characteristics for Lodzkie and peer regions are summarized in Table 3.

Table 3. Economic and R&D characteristics in Lodzkie and peer regions in 2016

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (PPS per inhabitant) 2016</th>
<th>R&amp;D expenditure (GERD) in % of GDP 2015</th>
<th>Employmen in R&amp;D (%) 2015</th>
<th>R&amp;D expenditures, sectoral share in % 2015</th>
<th>Unemployment rate 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mazowieckie (PL)</td>
<td>31 700</td>
<td>1,74</td>
<td>1,24</td>
<td>39</td>
<td>24</td>
</tr>
<tr>
<td>EU 28</td>
<td>29 200</td>
<td>2,04</td>
<td>1,34</td>
<td>55</td>
<td>13</td>
</tr>
<tr>
<td>Midi-Pyrénées (FR)</td>
<td>27 900</td>
<td>4,75</td>
<td>2,49</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td>Jihovýchod (CZ)</td>
<td>23 600</td>
<td>2,83</td>
<td>1,74</td>
<td>59</td>
<td>12</td>
</tr>
<tr>
<td>Wielkopolskie (PL)</td>
<td>21 700</td>
<td>0,74</td>
<td>0,59</td>
<td>40</td>
<td>19</td>
</tr>
<tr>
<td>Śląskie (PL)</td>
<td>20 700</td>
<td>0,61</td>
<td>0,53</td>
<td>44</td>
<td>17</td>
</tr>
<tr>
<td>Łódzkie (PL)</td>
<td>18 600</td>
<td>0,67</td>
<td>0,46</td>
<td>30</td>
<td>21</td>
</tr>
<tr>
<td>Nord-Vest (RO)</td>
<td>14 900</td>
<td>0,41</td>
<td>0,18</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Sud-Est (RO)</td>
<td>14 500</td>
<td>0,08</td>
<td>0,10</td>
<td>16</td>
<td>57</td>
</tr>
<tr>
<td>Świętokrzyskie (PL)</td>
<td>14 300</td>
<td>0,61</td>
<td>0,24</td>
<td>36</td>
<td>-</td>
</tr>
<tr>
<td>Dél-Alföld (HU)</td>
<td>14 000</td>
<td>1,69</td>
<td>0,59</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Sud-Muntenia (RO)</td>
<td>13 400</td>
<td>0,34</td>
<td>0,19</td>
<td>67</td>
<td>24</td>
</tr>
<tr>
<td>Észak-Magyarország (HU)</td>
<td>13 000</td>
<td>1,1</td>
<td>0,27</td>
<td>63</td>
<td>1</td>
</tr>
</tbody>
</table>

\(^2\) http://ec.europa.eu/growth/industry/innovation/facts-figures/regional_en

\(^3\) https://rpo.lodzkie.pl/images/konkurs_2.3.1_cop_28122015/RSI_LORIS_2030.pdf
According to economic characteristics, Lodzkie is doing relatively well when compared with other peer regions, and its position has been improving. Within Poland, Lodzkie is sixth in GDP per capita in PPS\textsuperscript{21}. However, if one takes only regional peers into account, three out of four are better off than Lodzkie. The structural peers are behind Lodzkie, and they are not catching up. The aspirational peers are better off, but the difference between Lodzkie and its aspirational leaders has been decreasing, both in absolute and relative terms. Unemployment rate oscillates around Polish mean, and since 2012, it has been below the EU28 mean (see Error! Reference source not found. in Annexes). Lodzkie is doing relatively well in another economic characteristic, monthly gross wages, and salaries. In 2017, Lodzkie was seventh in Poland with 92% of the Polish mean (see Error! Reference source not found. in Annexes). Lodzkie has improved when compared with its regional peers; compared to 2008 it has left Opolskie, Wielkopolskie, Lubelskie, and Podlaskie behind.

The potential problem in Lodzkie is low and stagnating R&D expenditures and employment in R&D; only approximately 0,6% of GDP is invested into R&D activities, which is much less when compared with EU28 mean (2%) and Poland (1%). The R&D data gives us an interpretative context for evaluation of the competitiveness and innovation potential of the studied region (see Figure 15 in Annexes). From the regional peers, only Swietokrzyskie is worse off in R&D expenditures. Moreover, regions behind Lodzkie are catching up, while Lodzkie’s R&D expenditures have been stagnating since 2011. The relatively low R&D expenditures may be influenced by the structure of employment in R&D by economic sectors. Lodzkie has approximately one third (30%) of R&D employees in the business sector and almost one half (49%) in the higher education sector\textsuperscript{22}. Compared to regional peers, both Slaskie and Mazowieckie have higher shares of the business sector (44% and 39% respectively) (see Figure 16 in Annexes). Aspirational peers (Jihovýchod and Midi-Pyrénées) have significantly higher shares of R&D employees in the business sector (59% and 66% respectively). Higher shares of the higher education sector are characteristic for less developed regions (with underdeveloped business sector).

Lodzkie is moderately active in patenting, but it has significantly improved its position when European patents are considered. Registered intellectual property is an important indicator for innovation potential of the region. Almost 8% of all granted patents\textsuperscript{23} in Poland were granted to applicants from Lodzkie. Compared to Lodzkie regional peers, it is less than in Mazowieckie (12%), roughly the same as in Slaskie (8%), but significantly higher than in Swietokrzyskie (3%). Patenting activity has been relatively stable across years. A total number of patents granted in 2017 according to regions\textsuperscript{24} can be found in Eurostat, Polish statistical office, 2018; note: regions Lubuskie and Swietokrzyskie not included due to data availability; French regions relate to year 2013

\textsuperscript{21} http://stat.gov.pl/en
\textsuperscript{22} http://stat.gov.pl/en
\textsuperscript{23} Normalized by population
\textsuperscript{24} Patents are attributed to regions according the residency of the applicant. When there are applicants from two or more different regions, the patent is split equivalently between those regions. The absolute numbers were normalized according to population.
Figure 17 in Annexes. Lodzkie is doing better than the majority of structural peers but worse than aspirational peers in registered European patents. The patent activity in Lodzkie is slightly lower (20 EPO patents per million inhabitants) than in Jihovýchod in Czechia (27) and five times lower than in Midi-Pyrénées in France (95). From regional peers, Lodzkie is the leading region in European patents, only Mazowieckie having slightly higher values. The structural peers are far behind Lodzkie except for Dél-Alföld, which has similar values. Lodzkie has significantly improved between 2008 and 2012 (the number more than doubled from 8 to 19).

Supply-side Lodzkie

The goal of the supply-side analysis is to identify strong regional competencies in the knowledge generation subsystem with a potential for university-business cooperation. The competencies identified in the supply-side are later compared with competencies identified in the demand-side and gaps and overlaps between these competencies are uncovered. Besides the identification of key technology fields and specific competencies, the key stakeholders are identified.

**Patenting activity**

Textile and paper machines emerge as a strong field in Lodzkie’s knowledge generation institutions. This is in line with historical specialization of the region in textiles. Textile-related fields have higher shares in both patenting and publication activity when compared with average numbers for Poland. The structure of the patent portfolio according to technology fields is captured in Figure 2. Altogether, there are 1050 active patents with at least one applicant from the supply-side. It is the biggest technology field in Lodzkie having 13% of all active patents there, while in Poland it is responsible for approximately 1% of all patents. The Lodz University of Technology and Textile Research Institute Lodz are the main driving institutions for the Textile and paper machines technology field specialization. The share of patents from this field, as well as absolute numbers of active patents, are the highest in these two institutions.

The textile field includes a specific sub-field, which is highly represented at universities and research institutes, nanosciences. There are 27 EU funded projects including the nano-related topics. Moreover, more than 10% of all patents is related to nanomaterials (every fourth patent in the textile and paper machines technology field). Moreover, the BioNanoPark, the biggest supporting infrastructure in the region, focuses on nanomaterials building on the historical legacy of the textile industry (as stated by its management). Individual universities and research institutes in Lodzkie have a higher share of nano-related publications compared to other regions.

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25 [https://ec.europa.eu/eurostat/data/database](https://ec.europa.eu/eurostat/data/database); the results are not fully comparable with the data from Poland. In Poland all patents were considered, in this case only European patents. The most recent year available in Eurostat database is 2012. The number of European patents is normalized by population.

26 It is about 16 European patent applications per million inhabitants in 2012.

The medical technology is the second strongest field capturing 8% of all patents owned by universities and research organizations, while the Polish average is 4%. Almost one-fourth of these patents are international indicating high innovation potential of these inventions. In the medical technology field, Lodz University of Technology is the leader in patents, followed by Institute of Biopolymers and Chemical Fibres and Medical University (see Table 4).

Similarly, the relatively high share of patents is in pharmaceuticals (8%), which is significantly higher when compared to the Polish average (3%). Similarly, macromolecular chemistry and polymers (having 8% in Lodzkie and 2% on average in Poland), and biotechnology (4%, 1%) are more common in the patent portfolio of universities, and research institutes from Lodzkie when compared with other regions. The leader behind pharmaceutical patents is the University of Lodz, followed by the Medical University of Lodz, The Institute of Medical Biology of Polish Academy of Sciences, and The Centre of Molecular and Macromolecular Studies of Polish Academy of Sciences. The leader in macromolecular chemistry and polymers and biotechnology is the Technical University in Lodz followed the Institute of Biopolymers and Chemical Fibers (macromolecular chemistry and polymers) and Institute of Horticulture (biotechnology).

The Lodz University of Technology is, by far, the most active knowledge generation institution in patenting, having more than 60% of all active patents. The active patents according to applicants are pictured in Table 4. Aside from the three most significant supply-side stakeholders (the Medical University of Lodz, Lodz University of Technology, and University of Lodz), there are several other important stakeholders. Institute of Security Technologies MORATEX, Centre of Molecular and Macromolecular Studies of Polish Academy of Sciences, Textile Research Institute, and Institute of
Biopolymers and Chemical Fibers are also important supply-side stakeholders behind the three leaders. They are complementing the regional competencies in Organic fine chemistry, Macromolecular chemistry, polymers, and Textile and paper machines.

**Lodz University of Technology (LUT)**

LUT has both a Centre for Technology Transfer (CTT) and a Special Purpose Company (SPC) called the Technology Transfer Centre Ltd. The CTT employs four FTE; one has as scientific (engineering) background while the other three have a business (commercial) background. The SPC has one full time employee with a business background plus two Board members – one from STEM and the other from business. Between them, the two units cover all TT activities. They work closely together but the SPC focuses on most strongly in the end of the TT process – seeking business partners, finalizing all licensing deals and creating spinoff companies. It is interesting to note that ‘scouting’ inside the university is not a regular to even occasional task for either of the units. This may imply that an ‘open door’ approach is favored over active scouting or that the capacity of both units is fully occupied through projects such as the national Incubator+.

**Technology Transfer outputs from the university are strong, with evidence of IP being secured through national, EP and PCT routes.** Annual income from licensing is significant. The university is also starting spinout companies and talking an equity stake as well as supporting start-up activity. The university is not currently collecting consolidated data regarding contract research but has existing and ongoing strategic activities with Airbus Lodz, Wielton and BSH/Siemens (Lodz branch).

<table>
<thead>
<tr>
<th>R&amp;D institution</th>
<th>Specialisation</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lodz University of Technology</td>
<td>Textile and paper machines (85); Organic fine chemistry (68); Medical technology (64); Macromolecular chemistry, polymers (59); Other special machines (42); Biotechnology (39)</td>
<td>691</td>
</tr>
<tr>
<td>University of Lodz</td>
<td>Pharmaceuticals (33); Control (16)</td>
<td>111</td>
</tr>
<tr>
<td>Centre of Molecular and Macromolecular Studies of Polish Academy of Sciences</td>
<td>Organic fine chemistry (20); Pharmaceuticals (14); Macromolecular chemistry, polymers (13)</td>
<td>64</td>
</tr>
<tr>
<td>Institute of Security Technologies MORATEX</td>
<td>Other special machines (24); Other consumer goods (20); Textile and paper machines (5)</td>
<td>63</td>
</tr>
<tr>
<td>Textile Research Institute</td>
<td>Textile and paper machines (30); Surface technology, coating (7)</td>
<td>60</td>
</tr>
<tr>
<td>Institute of Biopolymers and Chemical Fibres</td>
<td>Macromolecular chemistry, polymers (15); Medical technology (11); Textile and paper machines (10)</td>
<td>44</td>
</tr>
<tr>
<td>Research Institute of Horticulture</td>
<td>Other special machines (16)</td>
<td>27</td>
</tr>
<tr>
<td>Medical University of Lodz</td>
<td>Pharmaceuticals (11); Medical technology (4)</td>
<td>22</td>
</tr>
<tr>
<td>Institute of Leather Industry in Lodz</td>
<td>Chemical engineering (5); Other consumer goods (5)</td>
<td>16</td>
</tr>
<tr>
<td>Institute of Medical Biology of Polish Academy of Sciences</td>
<td>Pharmaceuticals (8)</td>
<td>15</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>1050</td>
</tr>
</tbody>
</table>

Source: Orbit by Questel, 2018
European research projects

However, excellence is not revealed exclusively by patenting. Participation in European projects is an important indicator of innovation potential. European projects, Horizon 2020 and 7th Framework Program (further as FP7), are international, collaborative, and highly competitive. The most successfully supported fields can indicate stronger competence within the region. The most common topics in these programs are summarized in Error! Reference source not found.. Altogether, there were more than 100 projects supported; these projects were worth almost 20 mil. EUR\textsuperscript{28}.

The biggest contribution by the European Commission for the H2020 and FP7 projects in Lodzkie was by far in the topic of health. Altogether, there were 21 participations worth more than 7,5 mil. EUR. All of these participations, including coordinated projects, were at the Medical University of Lodz. Nofer Institute of Occupational Medicine is another institution active in the health-related topics with three participations in European research projects.

Besides health, the most common topics include nanotechnologies (4,9 mil. EUR), climate and environment, energy efficiency, and food. There are four institutions, which acted as coordinators in these projects. Being a coordinator in an international collaborative project is quite prestigious, these institutions must be respected partners abroad. There are four institutions from the supply-side with experience as coordinators: Medical University in Lodz, Lodz University of Technology, University of Lodz, and Research Institute of Horticulture. These coordinated projects are in the topics mentioned above: health, biotechnology, nanoscience, environment, food, and energy efficiency.

Table 5. Top 10 R&D institution participations in 7th Framework Program and Horizon 2020 (years 2007-2018)

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>EC contrib.</th>
<th>N</th>
<th>Topic/program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medical University of Lodz</td>
<td>C &amp; P</td>
<td>7 623 963</td>
<td>21</td>
<td>Health</td>
</tr>
<tr>
<td>Lodz University of Technology</td>
<td>C &amp; P</td>
<td>4 862 421</td>
<td>27</td>
<td>Nanosciences, nanotechnologies, materials</td>
</tr>
<tr>
<td>University of Lodz</td>
<td>C &amp; P</td>
<td>2 498 674</td>
<td>20</td>
<td>Science in society; Environment (including Climate Change)</td>
</tr>
<tr>
<td>Institute of Horticulture</td>
<td>C &amp; P</td>
<td>1 516 585</td>
<td>13</td>
<td>Food, agriculture and fisheries, and biotechnology</td>
</tr>
<tr>
<td>Institute of Biopolymers and Chemical Fibres</td>
<td>P</td>
<td>721 424</td>
<td>3</td>
<td>Sustainable, resource-efficient and low-carbon technologies</td>
</tr>
<tr>
<td>European Regional Centre for Ecohydrology</td>
<td>P</td>
<td>583 732</td>
<td>5</td>
<td>Protection of the environment, sustainable management of natural resources</td>
</tr>
<tr>
<td>Nofer Institute of Occupational Medicine</td>
<td>P</td>
<td>295 679</td>
<td>3</td>
<td>Methods and data; Preventing disease</td>
</tr>
<tr>
<td>Research and Innovation Centre Pro-Akademia</td>
<td>P</td>
<td>114 375</td>
<td>1</td>
<td>Market uptake of energy innovation</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>18 216 853</td>
<td>101</td>
<td></td>
</tr>
</tbody>
</table>

Source: Cordis, European Commission; note: Role means a role in a project, C = coordinator, P = participant; N means the number of participations; in the last column there are the most relevant topics or programs according to the number of participations

Rankings and publication activity

\textsuperscript{28} European contribution
The excellence of the Medical University of Lodz and the importance of health-related topics is also revealed by publication activity. The Medical University of Lodz is considered the best university within the Lodzkie region according to Webometrics Ranking of World Universities\(^{29}\) (11\(^{th}\) in Poland). It is followed by the Lodz University of Technology (17\(^{th}\)), and the University of Lodz (20\(^{th}\)). Medical University is the second most excellent medical university in Poland after the Medical University of Warsaw (9\(^{th}\) in the ranking). However, there are probably more excellent faculties hidden in the rankings under bigger universities (such as Jagiellonian University in Cracow, first in the ranking in Poland, 406\(^{th}\) worldwide).

Medical University of Lodz (MUL)

The MUL has both a Centre for Technology Transfer and a Special Purpose Company (SPC). The primary responsibilities of the CTT are sales, IP protection and ‘acceleration’ while the SPC is responsible for start-ups. The CTT is large with over 19 employees of which 5 have a scientific/research background and three are from the business sector. The SPC employees 9 FTE of which one has a scientific background and three are from the business sector. The two units cover virtually the full range of classic research commercialization activities on a ‘regular’ or ‘occasional’ basis, with the exception of patent valuation (‘rare/never’), as well as some related specifically to the medical sector (e.g. clinical trials and coordinated care models). They also support ‘acceleration’ of projects.

There is strong technology commercialization activity including patenting via the national, EPO and PCT routes, equity-based spinoffs, and significant income from technology licensing. The Medical University of Lodz does not appear engaged in contract research activities but indicated that it has strategic research partnerships in place with: COMARCH – long term research collaborator in projects; ROCHE – PhD, coop in Clinical research centre; GE health care- acceleration programs; Mediguard-cooperation in preparation of innovation in healthcare.

In general, the Medical University of Lodz, Lodz University of Technology, and the University of Lodz can be considered as the three most important knowledge creators in the Lodzkie region. These universities are considered the best in the Scimago composite ranking\(^{30}\), Medical University as the most excellent university in Lodzkie, 15\(^{th}\) in Poland, followed by Lodz University of Technology (21\(^{st}\)), and University of Lodz (23\(^{rd}\)). Interestingly, Medical University of Lodz is considered the most excellent within the region in the innovation aspects as well; however, there are not that many active patents (see Table 4). However, in the Scimago institutions ranking, innovation potential is measured by a so-called innovative knowledge (scientific publication output from an institution cited in patents) and

\(^{29}\) [http://www.webometrics.info/en](http://www.webometrics.info/en); research excellence assessed according to the number of papers amongst the top 10% most cited papers in 26 disciplines in period 2012–2016

\(^{30}\) [https://www.scimagoir.com/institution.php?idp=6762](https://www.scimagoir.com/institution.php?idp=6762);
technological impact (percentage of the scientific publication output cited in patents). The ranking of Polish universities is very similar in Polish Perspektywy University Ranking31.

It is important to bear in mind that the report draws conclusions based on a limited number of indicators (patents, European projects, publications, rankings). However, these indicators should provide relatively good information about regional specialization of universities and research institutes. To understand the regional environment more in depth, it is necessary to go beyond the quantitative data and talk to individual stakeholders. Thus, the quantitative analysis is complemented by information gathered during interviews with the key stakeholders.

Supporting infrastructure

BioNanoPark located on the outskirts of Lodz is the biggest infrastructure supporting the cooperation between academic research and business in the region. BioNanoPark focuses mainly on nano-sciences building on the textile industry legacy in the region. Besides nano-sciences, the BioNanoPark focuses on biotechnologies, molecular analyses (with a supercomputer ANUZ enabling real-time molecular simulations), and personalized medicine. BioNanoPark is a joint undertaking of the region, city, and the Lodz University of Technology. It is a mixture of the research institute, technology park, and innovation centre. The goal is to have about one-third of the income from research commercialization; however, management indicates that this may not be a realistic goal. There is a problem with weak cooperation between academia and industry; several private companies mentioned that it is not easy to cooperate with BioNanoPark. However, there is an incubator with 44 companies (the majority in IT though). Six out of these are said to have strong cooperation with universities. There are some companies worth mentioning such as AI Architects, Eurofins Polska, and Napiferyn BioTech.

SkyHUB is relatively new supporting infrastructure, mainly offering co-working space and services for young companies and entrepreneurs. It was founded in March 2018 by the city of Lodz, and it has been very active since. The co-working space is for free as well as mentoring services. SkyHUB helps to cultivate an entrepreneurial spirit in the City and subsequently the region. There are several promising start-ups in SkyHUB, such as Bilberry. Even though there is some cooperation with local universities, there is a need for more intensive cooperation. EIT Health hub and Alliance for Life are other supporting infrastructures, which universities perceive as important for technology transfer activities.

There are also technology transfer centres at the major universities. However, the companies interviewed had a low awareness of the CTTs, or they do not use them as a point of contact with universities; interestingly, the majority of interviewed companies called for a single point of contact. Companies often start a collaboration with individuals. The collaboration is, in the majority of cases, based on personal contacts, there is not much happening in an official way through CTTs. In addition, the Regional Innovation Strategy notes that university CTTs do not presently fulfil the role they should.

31 http://www.ranking.perspektywy.org
The infrastructure exists (including databases with contacts online\textsuperscript{32}), but more trust building and marketing is needed. Moreover, there is very little cooperation between the CTTs themselves. Their cooperation might leverage some activities, which are difficult to implement due to human resources and money limitations\textsuperscript{33}.

There are some good practice examples at universities in Lodzkie. The universities reported several strategic business partners as well as technology licensing. The long-term partners universities mentioned in the survey included Airbus Lodz, Wielton, BSH/Siemens (Lodz University of Technology), Gebako (University of Lodz), COMARCH, ROCHE, GE health care, Mediguard (Medical University of Lodz). Universities and their CTTs identify strengths especially in high-quality research with application potential, while weaknesses in lack of incentives for researchers to focus on the application research instead of solely on fundamental research and limited (human) capacities. In terms of CTT employees’ skills, they feel strong in finding partners for contractual research and in intellectual property protection. However, the lack skills in valuing patents, assessing technology strengths, and preparing new spin-off companies.

Universities declare an interest in a spin-off and start-up company creation. However, compared to other countries (and some regions in Poland), the number of start-ups and spin-offs is rather low\textsuperscript{34}. The Lodz University of Technology reports nine spin-off companies and the Medical University of Lodz reports six spin-off companies and 17 companies in the university incubator. Generally, these two universities are the most active in entrepreneurship promotion through several programs like 500 innovators program, Creative zones, Start-up boot camp or acceleration program. However, compared to other countries (and some regions in Poland), the number of start-ups and spin-offs is rather low.

Demand-side Lodzkie

Employment and wages

Several economic fields stand out in the Lodzkie region such as the manufacturing of wearing apparel and textiles. These two sectors have much higher shares of the workforce when compared with the Polish average. In these fields, employment is more than three times higher when compared to the Polish average. The former field is the biggest one according to the employment structure. However, it is important to take wages and salaries into account as well. Both the manufacture of wearing apparel and manufacture of textiles face negative a trend in wages and salaries (see Figure 4).

The biggest stakeholder in the textile-related field is Union Industries Polska focusing on technical (often non-woven) textiles. It is also one of the most dynamic companies in the region (see Table 7). The textile industry also has the higher share of patents when compared with overall Polish structure. However, the position of both sectors, according to the average wages and salaries, has weakened in

\textsuperscript{32} Yet the databases are often incomplete and it is difficult to search them

\textsuperscript{33} See an example of cooperation between Czech CTTs, https://www.transfera.cz/en/

\textsuperscript{34} http://startuppoland.org/wp-content/uploads/2017/10/SP_raport17_ENG_singlepages_lr.pdf
the last few years. This field is well represented in the patent activity and EU funded projects as well. It is usually connected with non-woven textile and nanomaterials in general (see Bergamo tecnologie and Ameox with focus on nanotechnologies in Error! Reference source not found. in Annexes).

The manufacture of electrical equipment and other manufacturing has a strong position in the region, it has been improving both concerning employment, and wages and salaries. The manufacture of electrical equipment is an economic sector with the highest wages and salaries when compared to the wages and salaries in the same field in other regions (approximately on 130% of Polish average, see Figure 3). It is reflected in the patenting activity, but there are not many specialized companies in this field except for companies in automotive-related fields.

Besides mechanic engineering and electric equipment manufacturing sectors, many companies are serving as manufacturing and service suppliers to these sectors in the relevant value chains. Olympus Sky providing IT services is a good example. The company provides innovative cybersecurity solutions with headquarters in Lodz and sister company in the USA. They cater a lot for automotive. Another example is Pulpack specializing in packaging solutions for computer companies such as Dell and HP.

The key private companies in this field are Wielton and Borg automotive. Wielton is a manufacturer of semi-trailers. It is one of the biggest companies according to turnover in the region; moreover, it has experienced quite significant growth. Borg automotive focuses on remanufacturing of automotive parts. Borg automotive has the highest turnover of the companies considered as gazelles (with higher than 20% growth in the last three years). The manufacture of motor vehicles, trailers and semi-trailers sector has significantly lower than average employment and lower than average wages and salaries when compared with average Polish figures, and these figures have even been decreasing (see Figure 3 and Figure 4). The employment, and wages and salaries in the region reflect the bigger added value and innovativeness of the specialized automotive parts compared to the manufacture of motor vehicles as such.

Olympus Sky Sp. z o.o.

Olympus Sky offers unique cybersecurity solution for corporate clients. The majority of clients are abroad, especially in USA. Their solution is technologically unique, there is no direct competition, but huge competition in substitute products. However, it is too novel for some conservative industries. They are based in Lodz, but they have a sister company in USA. The R&D is only in Poland in Lodz.

Some of the founders have university background (Lodz University of Technology), they are former researchers. Thus, the relations with the university are quite good, yet mainly informal and based on personal contacts. They successfully cooperate on joint doctoral programs (informally) with the university. Olympus Sky, or the partner company Fast Logic, is employing PhD students but they are supporting the students in their studies as well. All the students, so far, have completed their PhD studies. Yet, they still struggle with the lack of employees. They have a joint research project (NCBR)
with university developing a radically new technical solution they will licence afterwards. However, it is with the Technical University in Warsaw.

Olympus Sky considers the biggest barrier in cooperation with universities a difference in perception of a delivery (academic vs. practical) and approach to work at university. There is too long a time necessary for finishing the prototype, which is not in line with how their business works. They are still open for cooperation, but some interesting research questions with potential for a radical innovation (such as in the case with the Technical University of Warsaw) would have to appear. In this case, the time would not be that a pressing issue and cooperation might be successful.

Figure 3. Employment and wages in economic fields in Łódzkie in 2015, compared to Poland
Source: Eurostat, 2018; note: blue colour refers to manufacturing, yellow colour refers to services; employment in the economic field is calculated as a share of employment in a region on the share of employment in Poland (Poland=100), wages and salaries in calculated analogically; the number of employees in an economic field is illustrated by the size of the node; fields manufacture of tobacco products, manufacture of coke and refined petroleum products, manufacture of other transport equipment; water transport, air transport and postal and courier activities are not included due to the small number of actors. Figures are visually split into four different quadrants, which relate to the competitiveness of respective economic sectors and its evolution in time. The upper right quadrant comprises economic fields with both higher than average employment and higher than average wages and salaries (and positive trends when evolution in time is considered). On the other hand, in the lower left quadrant, one can find economic fields with both lower than average employment and lower than average wages and salaries (and negative trends). Since the figure works with relative numbers, the size of the node corresponds with the number of employees in an economic field to account for absolute sizes of those fields.
Figure 4 Changes in employment and wages and salaries in selected economic fields in Lodzkie between 2010 and 2015

Source: Eurostat, 2018; note: blue colour refers to manufacturing, yellow colour refers to services; employment in economic field is calculated as a share of employment in a region in 2015 on the share of employment in region in 2010 compared with Poland (change in Poland=100, difference between Poland and Lodzkie in relative figures), wages and salaries in calculated analogically; the number of employees in an economic field is illustrated by the size of the node; 1 = Manufacture of furniture, 2 = Security and investigation activities, 3 = Services to buildings and landscape activities, 4 = Architectural and engineering activities; technical testing and analysis, 5 = Manufacture of machinery and equipment, 6 = Computer programming, consultancy and related activities, 7 = Warehousing and support activities for transportation, 8 = Repair and installation of machinery and equipment, 9 = Manufacture of motor vehicles, trailers and semi-trailers, 10 = Manufacture of basic pharmaceutical products and pharmaceutical preparations, 11 = Manufacture of chemicals and chemical products, 12 = Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials.
Economic output and economic growth

Chemistry (manufacture of basic chemicals) is one of the most dynamically growing economic sectors in the region. It has grown more than three times since 2011. In Table 6, there are ten of the fastest growing economic fields between 2011 and 2017. Bakery and farinaceous products field is the most dynamically growing economic field but is still relatively unimportant. The operating revenues have risen almost five times in the studied period. Other food products, as a similar field, has risen significantly as well; its economic output has nearly doubled. It is connected with the growing importance of biotechnology. There are some emerging players in this field, such as NapiFeryn BioTech, which is based in BioNanoPark. Chemical-related fields (Basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms; Plastic products) and metal processing related fields have also witnessed significant growth. Especially the growth of the manufacture of plastic products (174%) is significant due to its absolute size; it is responsible for more than 12% of the overall regional turnover. Manufacturing of rubber and plastic products, as well as the manufacture of chemicals and chemical products, have relatively high wages and salaries in Lodzkie, compared with other Polish regions, and it has been improving. Additionally, it is one of the most dynamic economic fields concerning turnover (see Table 6). However, it is not very well represented in patenting activity and EU funded projects; there are not any notable companies either.

Table 6. Ten fastest growing manufacturing fields according to revenues in Lodzkie by NACE

<table>
<thead>
<tr>
<th>Economic activity</th>
<th>Number of companies</th>
<th>Operating revenue 2016–2017 (thousands EUR)</th>
<th>Operating revenue 2011–2012 (thousands EUR)</th>
<th>share on manufacturing (%)</th>
<th>Relative growth compared to Polish average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of bakery and farinaceous products</td>
<td>6</td>
<td>83 379</td>
<td>17 468</td>
<td>1,1</td>
<td>250</td>
</tr>
<tr>
<td>Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms</td>
<td>8</td>
<td>119 077</td>
<td>33 430</td>
<td>1,5</td>
<td>288</td>
</tr>
<tr>
<td>Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers</td>
<td>3</td>
<td>418 777</td>
<td>178 503</td>
<td>5,3</td>
<td>131</td>
</tr>
<tr>
<td>Installation of industrial machinery and equipment</td>
<td>2</td>
<td>52 324</td>
<td>24 686</td>
<td>0,7</td>
<td>144</td>
</tr>
<tr>
<td>Manufacture of structural metal products</td>
<td>17</td>
<td>217 494</td>
<td>103 577</td>
<td>2,8</td>
<td>116</td>
</tr>
<tr>
<td>Manufacture of pulp, paper and cardboard</td>
<td>3</td>
<td>115 935</td>
<td>56 722</td>
<td>1,5</td>
<td>159</td>
</tr>
<tr>
<td>Manufacture of other food products</td>
<td>8</td>
<td>234 816</td>
<td>121 568</td>
<td>3,0</td>
<td>165</td>
</tr>
<tr>
<td>Manufacture of furniture</td>
<td>9</td>
<td>112 095</td>
<td>58 252</td>
<td>1,4</td>
<td>115</td>
</tr>
<tr>
<td>Casting of metals</td>
<td>5</td>
<td>59 994</td>
<td>31 511</td>
<td>0,8</td>
<td>145</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>44</td>
<td>950 580</td>
<td>545 634</td>
<td>12,1</td>
<td>105</td>
</tr>
</tbody>
</table>

35 only economic activities with 0,5% and higher share on manufacturing were included to disregard small and unimportant fields.
Source: Amadeus by Moody's Analytics / Bureau van Dijk, 2018; note: only economic activities with 0,5% and higher share on manufacturing are included; NACE Revision 2 dig.3 used; Relative growth compared to Polish average is calculated as a ratio between the growth (2017/2012) in operating revenues in the region and the growth in operating revenues in Poland.

The chemistry-related fields are important when absolute turnover is taken into account. The biggest player, according to turnover, is PGE górnictwo i energetyka konwencjonalna, an energy company with a turnover of almost 3 billion EUR. The second biggest company is Pelion, a group in pharmaceutical wholesale with a turnover of more than 2 billion EUR. Together, these companies are responsible for 20% of the turnover of all companies combined in the region. Pharmaceutical is generally an important sector; there are three more companies on the list of the biggest companies according to the turnover in the region – Polska grupa farmaceutyczna, Hurtap s.a., and Lek s.a. The biggest stakeholders from the demand-side, companies with the biggest revenues in the region, are pictured in Table 7!

Table 7. The companies with the biggest revenues in Łódzkie in 2017/2016

<table>
<thead>
<tr>
<th>Company name</th>
<th>NACE dig.2</th>
<th>NACE dig.4</th>
<th>Turnover in thousands EUR</th>
<th>Turnover average growth in % (last three years)</th>
<th>Share on the overall output</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGE GÓRNICTWO I ENERGETYKA KONWENCJONALNA S.A.</td>
<td>Electricity, gas, steam and air conditioning supply</td>
<td>Production of electricity</td>
<td>2 884 934</td>
<td>94</td>
<td>10,7</td>
</tr>
<tr>
<td>PELION S.A.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of pharmaceutical goods</td>
<td>2 281 503</td>
<td>107</td>
<td>8,4</td>
</tr>
<tr>
<td>ROSSMANN SUPERMARKETY DROGERYJNE POLSKA SP. Z O.O.</td>
<td>Retail trade, except of motor vehicles and motorcycles</td>
<td>Retail sale of cosmetic and toilet articles in specialised stores</td>
<td>1 606 642</td>
<td>112</td>
<td>5,9</td>
</tr>
<tr>
<td>POLSKA GRUPA FARMACEUTYCZNA S.A.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of pharmaceutical goods</td>
<td>1 177 473</td>
<td>99</td>
<td>4,4</td>
</tr>
<tr>
<td>JTI POLSKA SP. Z O.O.</td>
<td>Manufacture of tobacco products</td>
<td>Manufacture of tobacco products</td>
<td>1 087 278</td>
<td>106</td>
<td>4,0</td>
</tr>
<tr>
<td>WHIRLPOOL COMPANY POLSKA SP. Z O.O.</td>
<td>Manufacture of electrical equipment</td>
<td>Manufacture of electric domestic appliances</td>
<td>782 662</td>
<td>99</td>
<td>2,9</td>
</tr>
<tr>
<td>HURTAP S.A.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of pharmaceutical goods</td>
<td>414 324</td>
<td>113</td>
<td>1,5</td>
</tr>
<tr>
<td>WIELTON S.A.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers</td>
<td>386 196</td>
<td>144</td>
<td>1,4</td>
</tr>
<tr>
<td>DE HEUS SP. Z O.O.</td>
<td>Manufacture of food products</td>
<td>Manufacture of prepared feeds for farm animals</td>
<td>376 869</td>
<td>99</td>
<td>1,4</td>
</tr>
<tr>
<td>LEK S.A.</td>
<td>Manufacture of basic pharmaceutical products and pharmaceutical preparations</td>
<td>Manufacture of pharmaceutical preparations</td>
<td>360 812</td>
<td>97</td>
<td>1,3</td>
</tr>
</tbody>
</table>
The Bodies (coachwork) for motor vehicles, manufacture of trailers and semi-trailers sector representing more than 5% of the overall manufacturing output has experienced more than 200% growth (see Error! Reference source not found.). All the most dynamically growing manufacturing fields in Lodzkie are growing faster than they do on average in Poland. In Error! Reference source not found. in Annexes, there are concrete companies with the highest growth in the last three years. Only companies with a significant annual turnover (above 5 mil. EUR; having two exceptions with extreme growth) and at least 20% growth in the last three available years were considered.

The biggest companies considered as fast-growing are Borg automotive with business in remanufacturing automotive parts, Central fund of immovables from the Real estate field, Elprom distributing automotive fuel, Union industries Polska manufacturing non-wovens, and AB inition M. Matejczyk, C. Stańczak producing drugs and pharmaceutical products. The most dynamic company is Union industries Polska, which experienced explosive growth (more than 2.500%) in the last three years, probably connected with the company’s relocation to Poland and massive foreign direct investments. Very strong growth (around 1.000%) could also be observed in Metroport from the telecommunication field, Skalmet and CHS in wholesale and trading business, and August Faller manufacturing packaging products. There are no companies from the biggest players in the region; however, Wielton did not make it into the list since it experienced less dynamic growth in the last available year (14%) but has been very dynamic as well.

Patenting activity

The most common technology fields in patenting within private companies are in Other special machines (13%), Handling (10%), Other consumer goods (10%), Civil engineering (8%), Transport (8%), Food chemistry (7%), and Pharmaceuticals (5%). The whole patenting portfolio of private companies is captured in Figure 5. There are 1325 active patents with an applicant in Lodzkie, 289 of those patents have an applicant from a private company, which account for only slightly more than 21% of all active patents. When compared with benchmarking, the share of the Lodzkie region in patenting activity for private companies is much higher when compared with the overall share of patenting.
The most common technology fields at universities and research institutes, textile and paper machines, and medical technology are minor in the demand-side (2% and 4%). The overall structure of patent activity in Poland is relatively uniform except for civil engineering with almost 16% share (10% in Lodzkie). There are several other technology fields with a significantly stronger position in Lodzkie when compared with Poland: food chemistry (9% for Lodzkie demand-side, 3% in Poland), and pharmaceuticals (7% in Lodzkie, 2% in Poland).

The Handling technology field is represented by the company with the biggest revenue, PGE górnictwo i energetyka konwencjonalna with 11 registered patents and Eurobox Polska with 12 registered patents. The technology fields vary a lot; there are no technology fields that would dominate. Yet, there are some fields a bit more represented such as transport (Wielton), as a manufacturer of tippers and tautliners for traction units and one of the biggest companies in the region (see Table 8), handling (Eurobox Polska as a leader in packaging solutions), and pharmaceuticals and medical technology (Pabianickie Zakłady Farmaceutyczne Polfa from the Adamed group and MDH).

Table 8. Top patent applicants by companies in Lodzkie in 2018

<table>
<thead>
<tr>
<th>Company</th>
<th>Technology specialization</th>
<th>NACE dig.4</th>
<th>Turnover in thousands EUR</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>WIELTON S.A.</td>
<td>Transport</td>
<td>Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers</td>
<td>386 196</td>
<td>13</td>
</tr>
<tr>
<td>EUROBOX POLSKA SP. Z O.O.</td>
<td>Handling</td>
<td>Manufacture of corrugated paper and paperboard and of containers of paper and paperboard</td>
<td>53 104</td>
<td>12</td>
</tr>
<tr>
<td>MDH SP. Z O.O.</td>
<td>Medical technology</td>
<td>Manufacture of medical and dental instruments and supplies</td>
<td>12 361</td>
<td>12</td>
</tr>
</tbody>
</table>
### European research projects

The regional specific focus on textile, nanomaterials in particular, can be observed in the topics of supported European projects as well. Only application projects (i.e., the projects with the application and innovation potential such as Research and Innovation action and Innovation Action in the European Commission terminology)\(^{36}\) were considered. In Error! Reference source not found. in Annexes, there are private companies with the highest European Commission contribution in FP7 and Horizon 2020. All companies have participated only as partners with one exception, Bergamo tecnologie. This company is by far the most active SME in the region with more than 3 mil. EUR contribution. The company manufactures innovative façade solutions, the projects were focused on materials and new production technologies and efficient systems for buildings. There are three more companies in the regions with multiple participation in EU funded projects. The second most successful company about EU funded projects is Amepox Microelectronics. Both the company and the EU funded projects are focused on ICT and the use of nanotechnology.

### Clusters as business local innovation asset

Clusters are an important local innovation asset. There are many clusters active in Lodzkie, the Bioenergy for the Region Cluster, the CIT Central Poland Cluster, and the Cluster of Innovative Industry and Fashion are considered to have the biggest impact\(^ {37}\). There are several other notable clusters: Lodz-Mazovian Fruits and Vegetables Cluster Association, Lodz Construction Cluster “YOUR


HOUSE,” Kutno Technology Cluster (metal industry), and Waste management and Recycling Cluster. Bioenergy for the Region Cluster is the oldest cluster, an open cooperative initiative bringing together private companies, universities, and other players. It operates in the field of renewable energy sources. Together with this cluster, the Cluster of Innovative Industry and Fashion and the CIT Central Poland Cluster are the only clusters with the active participation of key supply-side stakeholders38. In general, the potential of clusters seems not to be fully utilized; none of the interviewed companies mentioned the importance of clusters in the regional innovation eco-system. However, there are best practice examples elsewhere, such as the Metal cluster in Podlaskie.

Gaps and overlaps Lodzkie

In this section, the report summarizes the competencies of the knowledge generation subsystem and the knowledge utilization subsystem and identifies gaps and overlaps. As mentioned in the theoretical part, there are several types of both gaps and overlaps (see Table 9). The gaps and overlaps can be pictured in a simple graph (see Table 9). The gaps and overlaps can be pictured in a simple graph (see Table 9).

Table 9. Gaps and overlaps between demand and supply-side in Lodzkie

<table>
<thead>
<tr>
<th></th>
<th>not significant in the demand-side</th>
<th>significant in the demand-side</th>
</tr>
</thead>
<tbody>
<tr>
<td>not significant in the supply-side</td>
<td>Other not mentioned elsewhere</td>
<td>- Manufacture of wearing apparel</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Automotive including Manufacture of electrical equipment</td>
</tr>
<tr>
<td>significant in the supply-side</td>
<td>- Medical technology</td>
<td>- Manufacture of textiles (specifically nanomaterials)</td>
</tr>
<tr>
<td></td>
<td>- Biotechnology</td>
<td>- Pharmaceuticals</td>
</tr>
<tr>
<td></td>
<td>- Chemistry (organic chemistry in particular)</td>
<td>- Polymers</td>
</tr>
<tr>
<td></td>
<td>- Energy Efficiency</td>
<td></td>
</tr>
</tbody>
</table>

Source: own construction

(i) The supply-side gap

The supply-side gap captures regional specialization of private companies, which is not matched by the expertise of universities and research institutes. This gap can be considered as an opportunity for universities since private companies have to search for this expertise outside the region. The interviewed companies claimed that they want to cooperate locally and are often frustrated by the missing regional expertise (and cooperate with the supply-side in different regions, such as in Warsaw)39.

There are two sectors, which are very strong in the region yet not matched by expertise at universities, manufacture of wearing apparel and automotive. Both sectors are underperforming

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38 Based on the information on member found online
39 However, the missing expertise is not the biggest barrier, it is usually a missing single-point-of-contact and difficult communication with the supply-side (time being usually the biggest issue).
when compared with other regions, and their position has been getting worse. However, especially in
the manufacture of wearing apparel, one of the biggest employers, there is a big opportunity for universities and research institutes to help innovate this sector, even though there seems to be very low activity in innovative activities in private companies. Moreover, several stakeholders mentioned the importance of creativity\(^{40}\) a multicultural ambiance of the city of Lodz. It was mentioned several times as a reason for multinational companies’ headquarters (or R&D centres) relocation into Lodz.

In the automotive sector, the missing expertise of public research organizations is especially mechanic engineering and electric equipment manufacturing. These economic fields are relatively one of the strongest in the region, both concerning employment, and wages and salaries. There are several intriguing companies in these sectors; Wielton, a manufacturer of semi-trailers (though most activities of this company are related to the manufacture of motor vehicles) and Borg automotive focusing on remanufacturing of automotive parts. The specialization of the supply-side resides in the sub-domains such as control, measurement, and electrical machinery. This specialization might be an opportunity especially for the Lodz University of Technology.

Majority of companies (specifically in this field but also elsewhere) mentioned lack of qualified engineers. It is important to remember that the primal role of higher education institutions is not technology transfer but providing qualified future employees for the private sector. However, the technology transfer can, in this context, function as a tool that would help to align the supply-side and the demand-side. The majority of companies want to cooperate, but they often have problems with contacting the right person at the university or the research institute. Companies also often mention problems with timely delivery of universities and lack of motivation for cooperation\(^{41}\).

(ii) The demand-side gap

The demand-side gap captures expertise not (yet) present in the demand-side but with strong expertise in the universities and research institutes. It is an opportunity for the private sector to utilize the expertise of the supply-side as well as for a start-up creation. However, in the case of start-ups, it is important to fit into the existing value chains.

The demand-side gap contains several fields. First, it is health-related topics, specifically the medical technology. The medical technology is a key field at both Medical University in Lodz and Lodz University of Technology. Regarding intellectual property (such as patents), it is the second most important technology field at public research organizations in Lodzkie. Moreover, there is an important infrastructure with relevant equipment, BioNanoPark, which is said not to be utilized to its full extent.

The second field, which can be considered as a gap with opportunity for companies, is biotechnology. It is also closely related to fields considered as overlapping, polymers and nanomaterials. However, specific biotechnology solutions are not sufficiently utilized by the demand-side (yet there are some

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\(^{40}\) Lodz is known as a film making centre of Poland with other creative industries present

\(^{41}\) This corresponds with the incentives in the Polish system where the third role of universities still has not gotten much attention. Yet it seems to be changing in other Central and Eastern European Countries such as Czechia of Slovakia.
EU funded research projects with private companies’ participation), even though there is a potential for the pharmaceutical businesses, which thrive in Lodzkie. On the other hand, there are some companies in the biotechnology fields emerging, such as NapiFeryn BioTech, which is based in the BionNanoPark Incubator. Similarly, organic chemistry expertise (the University of Lodz, Medical University of Lodz) can be utilized by the private sector more effectively.

Lastly, there are many activities in energy efficiency, especially in EU funded research projects. Energy efficiency expertise of the supply-side does not very well match the expertise of the private sector with one exception, Bergamo tecnologie (façade solutions) with 11 participations in EU funded research projects. There is also a potential for cooperation with the biggest company in the region, PGE górnictwo i energetyka konwencjonalna, which is active both in patenting and EU funded research projects. There are some start-up companies in this field though, such as Virtual Power Plant and W4E Energia Odnawialna, both based in BioNanoPark Incubator. The energy efficiency is also a key topic of the Bioenergy for the Region Cluster.

(iii) Overlapping specializations

The report identifies several sectors that are overlapping. However, the level of cooperation between companies and public research organizations is still rather low. There are some best practice examples; however, they cannot be generalized to a particular sector, and none of the sectors can be considered as overlapping and having strong cooperation between the demand-side and the supply-side.

First and most importantly, the manufacture of textiles is considered a sector strongly present both at companies and public research organizations (overlapping expertise). The regional specialization is specifically in non-woven textiles and nanomaterials. It is a very important technology field at major universities; moreover, there is a research institute focusing mainly on textile, the Textile Research Institute. There are many EU funded research projects in this field, and it is the most important technology field in patenting. The related economic field is one of the biggest employers and at the same time; there are higher wages and salaries in these fields compared to other regions. There are some big players such as Union Industries Polska as well as several notable start-ups (such as NapiFeryn BioTech). Moreover, there is a strong local innovation asset, specifically the BioNanoPark with both incubator and development area to attract foreign investments. The cooperation between companies and universities or research institutes exists but is considered by the majority of interviewed stakeholders as underutilized yet with high potential.

Pharmaceuticals can be considered as an overlapping field as well. It is represented in the regional patent portfolio more strongly than in other regions. The University of Lodz is particularly active in patenting in pharmaceuticals together with Medical University of Lodz and Institute of Medical Biology of Polish Academy of Sciences. The wages and salaries are below average when compared with other Polish regions, but the situation has been improving. Significantly, there are many companies which can utilized this expertise. There are huge companies in this field in Lodzie such as Pelion, Polska
grupa farmaceutycznam Hurtap, or Lek. However, the level of cooperation between the two subsystems is weak.

Another field considered as overlapping is polymers. It is related to the sector of manufacturing of rubber and plastic products and manufacture of chemicals and chemical products. It has relatively high wages compared to other regions, and it has been improving still. It is also one of the most important technology fields at public research organizations, especially at the Lodz University of Technology and The Institute of Biopolymers and Chemical Fibers.

The report considers the gaps and overlaps in the expertise of the private sector and public research only within respective regions, and it does not fully address the cooperation between these two subsystems across regions. The importance of the inter-regional university-business cooperation (relative to the intra-regional cooperation) can be approximated by the joint patent applications.

The network analysis shows that the cooperation between private companies and universities or research institutes happens mainly across regional borders. Although contractual research would be more suitable for this analysis, the co-ownership of patents shows that there is not enough demand-side capacity or will to cooperate on patent applications. The key stakeholder is visible – the Lodz University of Technology is in the centre of the network and connected to the majority of regional stakeholders. There are also some sub-clusters visible in the network; namely, sub-cluster centred around the Institute of Biopolymers and Chemical Fibers, sub-cluster centred around Moratex, and sub-cluster centered around the Institute of Horticulture.

**Bilberry Sp. z o.o.**

The Bilberry company is a start-up based in Lodz delivering innovative automated illumination solutions. It can be used as intelligent lighting systems for industry, but also for plant cultivation, which is very sensitive to lighting. Bilberry provides ready-made hardware and software solutions that help companies to increase energy savings; the payback period is close to one year. The company has been established in 2017 by two founders and has been developed very dynamically.

The Bilberry company cooperates strongly with the supply-side in Lodzkie, especially with the Lodz University of Technology. They have a student club at the university to communicate more effectively with students and attract potential excellent student to the company. Besides the student club, they sometimes use university laboratories for tests and for certifications. They have some cooperation with the Institute of Horticulture as well, developing specific lighting solutions for plants. Besides universities in Lodzkie, they have close cooperation with German universities, such as University in Halle. The biggest barrier in cooperation with universities is a timely response.

The private companies from Lodzkie, which are strong in patenting collaborate more often with companies and research institutes/universities outside the region. It is in contrast with the RIS3,
which claims that only a small percentage of enterprises (less than 2% of all entities) is actively looking for (and finds) the necessary services outside the region. This is somewhat surprising since it is often in topics, which are considered as Lodzkie supply-side regional specializations. See especially stakeholders such as Medana Pharma, and PGE gornictwo I energetyka konwencjonalna. In general, some companies active in patenting (such as Wielton) are often patenting without any cooperation with third parties. This finding was confirmed during the interviews, where the majority of companies innovate predominantly in-house or with specialists from outside the region. The network is presented in Figure 6.
Figure 6 Network based on co-ownership of patents by Lodzkie stakeholders, 2018

Source: own construction using Cytoscape software, note: the size of the nodes corresponds with the number of joint patents, the thickness of the edge corresponds with the number of joint patents between the two nodes connected by this edge.

- **Cooperation between supply-side and demand-side**
- **Cooperation between the same type of subjects**
- **Supply-side in Lodzkie**
- **Supply-side outside Lodzkie**
- **Demand-side in Lodzkie**
- **Demand-side outside Lodzkie**
Relation to RIS3 strategy

The RIS3 strategy of Lodzkie region contains the following priorities:

- Advanced construction materials (including design)
- Innovative agriculture and agri-food industry
- Energy (including renewable energy sources)
- IT and telecommunications (ICT)
- Modern Textile and Fashion Industry (including design)
- Medical Industry, pharmaceuticals and cosmetics (including health resort medicine)

The regional innovation strategy also mentions several technological areas, such as biotechnologies, nanotechnologies and functional materials, mechatronics, and communication and information technologies.

In general, the priorities mentioned in the RIS3 strategy matches quite well with the results in the gaps and overlaps analysis. However, there are some fields or technological areas that are missing in RIS3 and some areas that need to be explained in more depth. First, it is important to understand the difference between priority and specific regional expertise or specialization. The priorities can be considered as important areas that should be focused on, while regional specialization represents fields and areas with specific expertise of the region compared to other regions in Poland and other countries in the EU.

From the priorities mentioned in the RIS3 strategy, there are only two, which can be considered as overlapping in both the demand and the supply-side:

- Medical Industry, pharmaceuticals and cosmetics.

However, even in the case of modern textile and fashion industry, the specific regional expertise is mainly in non-woven textile and nanomaterials; thus, it is more textile for industrial use than a fashion industry. The medical industry, pharmaceuticals and cosmetics can be divided into two groups. Pharmaceuticals and cosmetics overlap quite well between private companies and public research organizations, while the medical industry including biotechnologies is stronger at universities. From the technology transfer perspective, there is a gap between the demand and supply-side in the medical industry and biotechnologies. However, this gap can be perceived as an opportunity for companies, which can capitalize on the public research organizations’ expertise in the region.

Another priority, advanced construction materials, partially matches the gaps and overlaps analysis. It is a regional specialization if one considers polymers and biopolymers, and textile-based materials. However, no evidence for mineral and composite-based materials, neither on the supply-side nor the demand-side, was found. There was no relation to the construction sector found either.

The innovative agriculture and agri-food industry are similar to the previous priority. It matches the observations very well if one considers fertilizers and other chemistry-based products only. Even in this
case, it is mainly a gap, the expertise and specialization residing mainly on the supply-side. On the other hand, if one considers food and food products, very little evidence that this is a regional specialization worth focusing on was found.

Considering the priority “energy,” the report identified it as a regional specialization of public research organizations without a match in companies. However, there is potential for companies, especially because of the presence of huge energy provider (PGE) in the region. No evidence for ICT being a regional specialization was found either; ICT is rather underperforming compared to other regions both in the supply and the demand-side.

There is one specific domain that cannot be found in RIS3 priorities, the manufacture of electrical equipment. This sector has the potential for technology transfer thanks strong presence of the sector in the region, including the developed values and supply chains (creating a critical mass). There are above average wages and salaries in this sector (compared to other regions) and the sector has a relatively high share of the workforce. There are strong companies present in the regions. The specific products are often related to automotive.

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42 Yet, it is still the biggest employer in the region
Podlaskie voivodship

Benchmarking Podlaskie

According to Regional Innovation Scoreboard⁴³, Podlaskie is considered a Modest Innovator with innovation performance increasing over time. It shows relative strengths in tertiary education and design applications and relative weaknesses in European patent applications and innovations within SMEs. There are some structural differences when compared with Poland as a whole and the EU28. Podlaskie is less densely populated (with lower urbanization levels), and it has a significantly higher share of employment in agriculture. In the Regional Innovation Strategy⁴⁴, the involvement of companies and research institutions in cooperation with each other is considered to be presently very low and unsuccessful and technology transfer to be ineffective. This, with low levels of internationalization of the business sector, is considered the main weaknesses of the region. The economic (GDP and unemployment) and R&D (employment and shares of different sectors) regional characteristics for Podlaskie and peer regions are summarized in Table 10.

Table 10. Economic and R&D characteristics in Podlaskie and peer regions in 2016

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (PPS per inhabitant) 2016</th>
<th>R&amp;D expenditures (GERD) in % of GDP 2015</th>
<th>Employment in R&amp;D (%) 2015</th>
<th>R&amp;D expenditures, sectoral share in % 2015</th>
<th>Unempl. rate 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Business enterprise sector</td>
<td>Governmen t enterprise sector</td>
<td>High education enterprise sector</td>
<td></td>
</tr>
<tr>
<td>Niederbayern (DE)</td>
<td>35 100</td>
<td>1,25</td>
<td>0,60</td>
<td>87</td>
<td>2</td>
</tr>
<tr>
<td>Mazowieckie (PL)</td>
<td>31700</td>
<td>1,74</td>
<td>1,24</td>
<td>39</td>
<td>37</td>
</tr>
<tr>
<td>EU 28</td>
<td>29 200</td>
<td>2,04</td>
<td>1,34</td>
<td>55</td>
<td>13</td>
</tr>
<tr>
<td>Limousin (FR)</td>
<td>24 600</td>
<td>2,83</td>
<td>1,74</td>
<td>59</td>
<td>12</td>
</tr>
<tr>
<td>Nord-Vest (RO)</td>
<td>14 900</td>
<td>0,41</td>
<td>0,18</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Sud-Est (RO)</td>
<td>14 500</td>
<td>0,08</td>
<td>0,10</td>
<td>16</td>
<td>57</td>
</tr>
<tr>
<td>Warminsko-Mazurskie (PL)</td>
<td>14 200</td>
<td>0,32</td>
<td>0,32</td>
<td>27</td>
<td>15</td>
</tr>
<tr>
<td>Podlaskie (PL)</td>
<td>14 100</td>
<td>0,41</td>
<td>0,18</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Dél-Alföld (HU)</td>
<td>14 000</td>
<td>1,69</td>
<td>0,59</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Sud - Muntenia (RO)</td>
<td>13 400</td>
<td>0,34</td>
<td>0,19</td>
<td>67</td>
<td>24</td>
</tr>
<tr>
<td>Észak-Magyarország (HU)</td>
<td>13 000</td>
<td>1,10</td>
<td>0,27</td>
<td>63</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Eurostat; Polish statistical office; 2018; data for French regions in 2013

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According to economic characteristics, Podlaskie is lagging and its situation has not very much improved in the last ten years. Podlaskie is far below the EU28 GDP per capita mean\(^45\) in 2016, having only 49%. Since 2007 it has slightly improved (from 45% in 2007). Podlaskie has similar GDP per capita as its structural and regional peers (between 13.000 and 14.900) except for Mazowiecie, which has significantly higher GDP per capita. Aspirational leaders are still far ahead. While the gap between Podlaskie and Niederbayern has been increasing (in absolute terms, decreasing in relative terms), the gap between Podlaskie and the second aspirational region, Limousin, has been closing (both in absolute and relative terms). The unemployment rate is quite low, on the EU28 mean level until 2013, then reducing more quickly than the EU28 mean, being significantly lower in 2017 (see Error! Reference source not found. in Annexes). The unemployment rates are generally very low in 2017, even in the case of structural peers. However, Podlaskie has one of the lowest gross wages and salaries in Poland; only three regions are worse off, one of them being the regional peer Warminsko-Mazurskie. The second regional peer, Mazowiecie, is the leading region in Poland with 122% of the Polish mean. Podlaskie has not improved much between 2008 and 2017, for all figures see Error! Reference source not found. in Annexes.

Although the economic indicators are rather low, R&D expenditures have risen significantly in the last few years. Still, only approximately 0,8% of GDP is invested in R&D activities. This is much less when compared with EU28 mean (2%) and Poland (1%). Warminsko-Mazurskie as a regional peer is far behind, while Mazowiecie, as the second regional peer, is the Polish leader, yet still below EU28 mean. A similar difference can be observed in the case of structural peers; Hungarian peer regions have higher expenditures into R&D, while others have significantly lower R&D investments than Podlaskie. Niederbayern as an aspirational leader is far away with more than 1,25% of GDP invested into R&D. The second aspirational leader, Limousin, has higher investments into R&D, but the difference has been decreasing (see Figure 15 in Annexes). The relatively low R&D expenditures may be influenced by the structure of employment in R&D by economic sectors. In Podlaskie, the share of the business sector is one of the lowest (24%) when compared with the peer regions. Warminsko-Mazurskie as a regional peer has a very similar structure, while Mazowiecie as the second regional peer has very different structure (39% in the business sector). From the peer regions, Niederbayern (as an aspirational leader) has the strongest share of business sector with 87%; second aspirational peer, Limousin, has 58% of R&D employment in the business sector. The results are pictured in Figure 16 in Annexes.

Podlaskie shows very low activity in patenting, especially in European patents. This low activity has not been improving in the last ten years. Registered intellectual property is an important indicator for innovation potential of the region. With only 2% share on the total number of patents granted in Poland\(^46\), Podlaskie is the second weakest region in Poland in this respect. Mazowiecie as a regional peer is the Polish leader. Another regional peer, Warminsko-Mazurskie, has roughly the same share of the total number of patents granted in Poland as Podlaskie. Patenting activity has been relatively stable during the studied years. The total number of patents granted in 2017 according to regions\(^47\) can be found in Figure

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\(^{45}\) [https://ec.europa.eu/eurostat](https://ec.europa.eu/eurostat)

\(^{46}\) Normalized by population

\(^{47}\) Patents are attributed to regions according to the residency of the applicant. When there are applicants from two or more different regions, the patent is split equivalently between those regions. The absolute numbers were normalized according to the population.
17 in Annexes. Podlaskie is performing worse than the majority of structural peers and significantly worse than aspirational peers in registered European patents. The patent activity in Podlaskie is very low, having only one European patent per million inhabitants. The aspirational leaders have an incomparably higher number of Europeans patents per million inhabitants (Niederbayern 160, Limousin 47). The structural peers from Romania are roughly at the same level as Podlaskie while the Hungarian regions (Dél-Alföld and Észak-Magyarország) are more active, especially Dél-Alföld. All regional peers are stronger in European patents. Podlaskie has not improved between 2008 and 2012.

**Supply-side Podlaskie**

The goal of the supply-side analysis is to identify strong regional competencies in the knowledge generation subsystem, which might be used for the development of the region. The competencies identified in the supply-side are later compared with competencies identified in the demand-side and gaps and overlaps between these competencies are uncovered. Besides the identification of key technology fields and specific competencies, the key stakeholders were identified.

**Patenting activity**

Medical technology is an important technology field in Podlaskie; 14% of patents at universities are from this field compared to just 4% in Poland as a whole. The structure of the patent portfolio in Podlaskie is captured in Figure 7. The Medical technology field is the second most common technology field after Measurement. However, all the patents in Medical technology field are Polish, and there are no international patents. Besides patenting, medical technology does not stand out in other indicators, such as application projects funded from the European Union and publication activity.

The leaders behind the medical technology are Białystok University of Technology and Medical University Białystok. Medical technology is the most important technology field at the Białystok University of Technology and the second most important technology field at the Medical University of Białystok. It is probably included in publications related to the Engineering field, which captures 30% of all publications at the Białystok University of Technology. The focus on medicine might be further supported by the University of Medical Science in Białystok. It is a relatively young institution; it was founded in 2003. It focuses primarily on cosmetics, physiotherapy, biotechnologies, and medical rescue. It is a private university, and it is oriented towards applied science; it owns one international patent (patent application so far, thus it does not appear in the statistics, see methodology). The university supports start-up creation; there are three successful examples of those: Biolamed, Biotomed, and Medrex.

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48 [https://ec.europa.eu/eurostat/data/database](https://ec.europa.eu/eurostat/data/database); the results are not fully comparable with the data from Poland. In Poland all patents were considered, in this case only European patents. The most recent year available in Eurostat database is 2012. The number of European patents is normalized by population.

49 It is about 8 European patent applications per million inhabitants in 2012.

50 In absolute terms, there are 20 patents out of 195 in Medical technology field in the supply-side.

51 [https://www.scopus.com](https://www.scopus.com)

52 Herbal preparation comprising an extract of melittis melittis melissophyllum for use in wound healing (EP3115055)
Bialystok University of Technology (BUT)

The BUT has a Special Purpose Company: The Institute of Innovation and Technology of Bialystok University of Technology. The company is responsible for both ‘direct’ and ‘indirect’ commercialization e.g. licensing and spin-off routes for technology commercialization. The unit currently employs 23 people of which 2 have a business background and none come from the research sector. The staff are involved in all classic Tech Transfer support activities and cite ‘sales’ as an important and regular activity in its own right.

There have been some licensing deals secured and the university has income from licensing, research contracts, and ancillary use of equipment and facilities. The university reported strategic partnerships in place with: AGA AS/REN (member of Linde Group), InConTech (university spin-off), PRAWDA.

Figure 7 Regional patent portfolio, supply side in Podlaskie region in 2018

Measurement is another technology, which typical for the Podlaskie universities; it has 16% share on the Podlaskie patent portfolio while only 6% in Poland. Similar to the Medical technology, there are no international patents in this technology field. There are no application projects supported by the European Union related to this field either. The Measurement technology field is the most represented in the patent portfolio of the Bialystok University of Technology and the University of Bialystok. This might be reflected in the topics of Mathematics and Physics and astronomy, which are relatively strong at both universities.

Source: Orbit by Questel, 2018

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53 [https://www.scopus.com](https://www.scopus.com)
It is often connected with automotive and other machinery (the specific electronic parts). It is also close to the Transport technology field.

The third technology field with a very different share of the patent portfolio at universities in Podlaskie (14%) compared to the overall structure in Poland (3%) is Pharmaceuticals. In marked contrast to the previous two technology fields, there are some international patents in this field; almost 20% of all patents (27) have international protection. The key stakeholders in this field are mainly the Medical University Białystok, followed by the Białystok University of Technology. The pharmaceuticals field does not belong to the most common fields in academic publications; they are represented only at the Medical University of Białystok, yet with only 7% share. The active patents according to applicants are pictured in Table 11.

Table 11. List of key supply-side stakeholders in Podlaskie region, active patents

<table>
<thead>
<tr>
<th>R&amp;D institution</th>
<th>Specialisation</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bialystok University of Technology</td>
<td>Medical technology (20); Measurement (19); Transport (12); Pharmaceuticals (7); Thermal processes and apparatus (7)</td>
<td>123</td>
</tr>
<tr>
<td>Medical University of Białystok</td>
<td>Pharmaceuticals (18); Medical technology (6); Measurement (5); Analysis of biological materials (4)</td>
<td>40</td>
</tr>
<tr>
<td>University of Białystok</td>
<td>Measurement (7); Analysis of biological materials (4); Biotechnology (4); Materials, metallurgy (4); Organic fine chemistry (4)</td>
<td>32</td>
</tr>
</tbody>
</table>

Source: Orbit by Questel, 2018

European research projects

Participation in European applications projects, as an indicator of innovation potential, is very weak in Podlaskie\(^{54}\). There are only three participations in these projects, yet one project with a coordinator from the region – Mammal Research Institute of the Polish Academy of Sciences\(^{55}\). The other two participations are from the Białystok University of Technology, and Białystok School of Economics. Altogether these three participations are worth 1,3 mil. EUR in European Commission contribution, 1,2 mil. EUR being the coordinated project in biodiversity; the other two projects are in transport and food, agriculture and fisheries, and biotechnology.

Rankings and publication activity

According to various rankings based on excellence, the quality of universities and research institutes is not very favourable. The Medical University Białystok is ranked 33\(^{rd}\) in Poland in the Webometrics Rankings of World Universities\(^{56}\). The Medical University Białystok is followed by University of Białystok (36\(^{th}\)), and Białystok University of Technology (37\(^{th}\)). Historically, the Białystok University of Technology is the most proactive (in term of technology transfer) supply-side stakeholder in Podlaskie. It opened a specialized laboratory (so-called “Fabric”) for solving problems of companies as soon as in 1985. Nowadays, Fabric was transformed into a special purpose vehicle. It is focused on prototyping, incubation

\(^{54}\) https://cordis.europa.eu/result

\(^{55}\) https://cordis.europa.eu/result/rcn/90443_en.html

\(^{56}\) http://www.webometrics.info/en; research excellence assessed according to the number of papers amongst the top 10% most cited papers in 26 disciplines in period 2012–2016
of new spin-offs, and technology transfer. This company now has six spin-offs and was seeking to increase this number to 8 by the end of 2018. The focus of companies in the portfolio is quite wide, from IT to hardware production. Similarly, the University of Medical Science recently established three new spin-off companies in life sciences.

In general, the Medical University Białystok, University of Białystok, and the Białystok University of Technology can be considered as the three most important supply-side stakeholders in the Podlaskie region. These universities are also considered the best according to the Scimago composite ranking\(^{57}\). Medical University Białystok is ranked 26\(^{6}\), University of Białystok 42\(^{nd}\), and the Białystok University of Technology 60\(^{th}\). The ranking of Polish universities is very similar in the Polish Perspektywy University Ranking\(^{58}\). The Białystok University of Technology is the most active R&D institution in patenting, having more than 60% of all active patents from the supply-side.

Besides the three main important universities, there are not many other notable players in the knowledge-generation subsystem. There are no other institutions, which would have an active patent. The relatively young University of Medical Science in Białystok does not have an active patent, but it has several promising patent applications. There are also Białystok School of Economics, The Mammal Research Institute of the Polish Academy of Sciences, Lomza State University of Applied Sciences, State Higher Vocational School of prof. Edward F. Szczepanik in Suwałki, The University of Finance and Management, and Białystok School of Economics. These supply-side stakeholders are not included in Perspektywy ranking\(^{59}\) and could not be found in any data sources mentioned above.

Supporting infrastructure

There are two notable stakeholders: Białystok Science and Technology Park (BPN-T) and East-West Science and Technology Park in Suwałki. The mission of the East-West Science and Technology Park in Suwałki is to increase socio-economic cohesion and economic growth of the macro-region of north-eastern Poland and consequently of Podlaskie Voivodeship by supporting entrepreneurship based on knowledge and advanced technologies and international cooperation\(^{60}\). Białystok Science and Technology supports the development of innovative enterprises, helps to find investors, shapes entrepreneurial attitudes among students, graduates, researchers, e.g. by organizing a number of projects such as „Hub of Talents Starting Platform,“ “Science Battle,” “Eastern Forum for e-commerce EastBiz.” Thanks to the access to knowledge, global connections as well as modern infrastructure, Park is constantly developing its offer. In cooperation with its business partners, BPN-T trains and advises nascent entrepreneurs. BPN-T infrastructure comprises the buildings of Technology Incubator and the Technology Centre\(^{61}\).

There are several Centers of Technology Transfer, which should play the role of a bridge between universities and companies. The Białystok University of Technology and Medical University of Białystok

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\(^{57}\) [https://www.scimagojr.com/institution.php?idp=6762](https://www.scimagojr.com/institution.php?idp=6762);

\(^{58}\) [http://www.ranking.perspektywy.org](http://www.ranking.perspektywy.org)


have their Special Purpose Vehicles (SPV) for commercialization purposes. However, companies interviewed often did not know about their role at the university (or even did not know about their existence); their role should be better communicated to the demand-side. There might also be an opportunity to improve in-house marketing, i.e., helping researchers understand the role of CTTs and SPVs and their services. There is a willingness to cooperate between CTTs, the Inkubator Innowacyjności + is often referred to as an example that has strengthened cooperation. However, the CTT teams (often very small) are frequently occupied with public grants and have limited capacities left for business activities.

**CTT employees indicated an interest in enhancing their technology transfer skills**, especially in valuing patents, searching for commercial partners for contract research (and joint projects), identifying potential technology adopters, and sales skills in general. The good practice examples are limited, but there are some strategic business partners such as AGA AS/REN, InConTech, PRAWDA (Bialystok University of Technology)

**From the interviews, it seems there is very little capacity to finance early-stage projects (TRL<5) in the region.** Low TRL of projects was mentioned in the survey as one of the key weaknesses by the Bialystok University of Technology. There is very limited private funding options (such as angel funds)\(^62\). Link to funding opportunities elsewhere is possible but “brain drain” is already a significant problem for employers in the region as many of the companies interviewed highlighted. On the other side, several companies (Applied Technology for example) mentioned relocation to Podlaskie due to very favourable incentives (cheap rent, subsidies for equipment). The local innovation asset, especially incubators, are not fully developed in the region to the point where they represent a similar incentive for relocation.

**Demand-side Podlaskie**

**Employment and wages**

Several business sectors are important in Podlaskie; the food-related sectors stand out the most. Manufacture of the food product is the biggest sector according to the number of employees. Moreover, it has higher shares of employees from the region when compared with the Polish average. There are also higher wages and salaries than the Polish average for this sector (see Figure 17). This higher employment in this sector was relatively constant between 2010 and 2015; relatively losing some employees yet gaining in wages and salaries. Closely related Manufacture of beverages also has a higher share of employees when compared with average employment in this sector in Poland; the wages and salaries are lower than the Polish average in this sector though.

According to turnover, 4 out of the 7 biggest companies are in the sector Manufacture of food products, 3 in Operating of dairies and cheese making. These are Spoldzielnia mleczarska mlekovita, Spoldzielnia mleczarska mlekpół w Grajewie (two biggest companies), Okregowa spoldzielnia mleczarska w Piatnicy, Spoldzielnia obrotu towarowego przemysłmleczarskiego, and Suempol (the only one not in dairy products but in Processing and preserving of fish, crustaceans, and molluscs). Together, companies in manufacture of dairy products represent 18% of the regional turnover; there are only a few smaller

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\(^62\) BRidge Alfa being an example how to mitigate this issue ([https://www.ncbr.gov.pl/programy/programy-krajowe/bridge/bridge-alfa/](https://www.ncbr.gov.pl/programy/programy-krajowe/bridge/bridge-alfa/))
companies, the biggest players dominate the sector (there are only 12 companies active in this sector). The biggest stakeholders according to the turnover are pictured in Error! Reference source not found. in Annexes.
Figure 8. Employment and wages in economic fields in Podlaskie in 2015, compared to Poland

Source: Eurostat, 2018; note: blue colour refers to manufacturing, yellow colour refers to services; employment in the economic field is calculated as a share of employment in a region on the share of employment in Poland (Poland=100), wages and salaries in calculated analogically; the number of employees in an economic field is illustrated by the size of the node; fields manufacture of tobacco products, manufacture of coke and refined petroleum products, manufacture of leather and related products; water transport, air transport, postal and courier activities and scientific research and development are not included due to small number of actors or data not available.
Figure 9. Changes in employment and wages and salaries in selected economic fields in Podlaskie between 2010 and 2015

Source: Eurostat, 2018; note: The figure shows the evolution of employment in economic fields (vertical axis) and changes in wages and salaries (horizontal axis) between 2010 and 2015. It is again split into four distinctive quadrants; the interpretation is a bit different though. The 100 on both axes refer to the average change in Poland, the position in the graph corresponds with the difference between Polish average and the change in the region. This figure helps to identify economic fields growing faster (or stagnating) in the Polish context. The upper right quadrant (quadrant I) shows fields with relative positive changes in both employment and wages and salaries in the region when compared with Polish average, while the lower left quadrant (quadrant III) shows fields with negative changes. Blue colour refers to manufacturing, yellow colour refers to services; employment in economic field is calculated as a share of employment in a region in 2015 on the share of employment in region in 2010 compared with Poland (change in Poland=100, difference between Poland and Podlaskie in relative figures), wages and salaries in calculated analogically; the number of employees in an economic field is illustrated by the size of the node; 1 = Architectural and engineering activities; technical testing and analysis, 2 = Manufacture of other non-metallic mineral products, 3 = Services to buildings and landscape activities, 4 = Repair and installation of machinery and equipment, 5 = Accommodation, 6 = Printing and reproduction of recorded media, 7 = Advertising and market research, 8 = Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, only economic fields with 1 000 persons and more
Economic output and economic growth

Manufacture of dairy products stands out in particular; it captures almost 18% of the regional turnover, totalling almost 2 billion EUR. Other food-related sectors with high revenues are Wholesale of food, beverages and tobacco (6% of the regional revenues), Wholesale of agricultural raw materials and live animals (2%), Processing and preserving of meat and production of meat products (2%), and Processing and preserving of fish crustaceans and molluscs (2%). For the top 20 economic fields according to revenues in Podlaskie see Error! Reference source not found.. Recently, there have been two dynamically growing companies in the food sector, Przedsiebiorstwo przemyslu spożywczego pepees manufacturing starch and starch products (the most dynamically growing company according to the turnover in the whole region), and Grupa agrocentrum manufacturing preparing feeds for farm animals.

Table 12. Top 15 largest economic fields according to revenues in Podlaskie by NACE

<table>
<thead>
<tr>
<th>Economic field (NACE dig 3)</th>
<th>Number of companies</th>
<th>Operating revenue 2016–2017 (thousands EUR)</th>
<th>Operating revenue 2011–2012 (thousands EUR)</th>
<th>Operating revenues change (2017/2012) (%)</th>
<th>Share on EA (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of dairy products</td>
<td>12</td>
<td>1,997,913</td>
<td>1,561,504</td>
<td>128</td>
<td>17,9</td>
</tr>
<tr>
<td>Other specialised wholesale</td>
<td>87</td>
<td>1,281,916</td>
<td>607,738</td>
<td>211</td>
<td>11,5</td>
</tr>
<tr>
<td>Construction of residential and non-residential buildings</td>
<td>54</td>
<td>820,265</td>
<td>453,234</td>
<td>181</td>
<td>7,3</td>
</tr>
<tr>
<td>Wholesale of food, beverages and tobacco</td>
<td>46</td>
<td>705,398</td>
<td>486,680</td>
<td>145</td>
<td>6,3</td>
</tr>
<tr>
<td>Retail sale in non-specialised stores</td>
<td>57</td>
<td>423,457</td>
<td>290,209</td>
<td>146</td>
<td>3,8</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>21</td>
<td>391,595</td>
<td>126,335</td>
<td>310</td>
<td>3,5</td>
</tr>
<tr>
<td>Non-specialised wholesale trade</td>
<td>56</td>
<td>364,235</td>
<td>161,210</td>
<td>226</td>
<td>3,3</td>
</tr>
<tr>
<td>Wholesale of household goods</td>
<td>37</td>
<td>273,879</td>
<td>221,803</td>
<td>123</td>
<td>2,4</td>
</tr>
<tr>
<td>Wholesale of agricultural raw materials and live animals</td>
<td>39</td>
<td>269,486</td>
<td>108,473</td>
<td>248</td>
<td>2,4</td>
</tr>
<tr>
<td>Processing and preserving of meat and production of meat products</td>
<td>26</td>
<td>243,905</td>
<td>231,593</td>
<td>105</td>
<td>2,2</td>
</tr>
<tr>
<td>Sale of motor vehicles</td>
<td>21</td>
<td>226,721</td>
<td>113,646</td>
<td>199</td>
<td>2,0</td>
</tr>
<tr>
<td>Processing and preserving of fish, crustaceans and molluscs</td>
<td>2</td>
<td>196,548</td>
<td>101,661</td>
<td>193</td>
<td>1,8</td>
</tr>
<tr>
<td>Manufacture of prepared animal feeds</td>
<td>8</td>
<td>186,538</td>
<td>87,912</td>
<td>212</td>
<td>1,7</td>
</tr>
<tr>
<td>Manufacture of agricultural and forestry machinery</td>
<td>4</td>
<td>171,221</td>
<td>207,170</td>
<td>83</td>
<td>1,5</td>
</tr>
<tr>
<td>Real estate activities on a fee or contract basis</td>
<td>36</td>
<td>151,965</td>
<td>139,706</td>
<td>109</td>
<td>1,4</td>
</tr>
<tr>
<td>Total</td>
<td>1,174</td>
<td>11,192,018</td>
<td>7,210,219</td>
<td>155</td>
<td>100,0</td>
</tr>
</tbody>
</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk, 2018; note: NACE Revision 2 dig.3 used; Operating revenues change is calculated as operating revenues from 2017 divided by operating revenue from 2012

Significantly higher employment and higher wages and salaries compared to overall Polish structure can be found in the Manufacture of wood and of product of wood and cork63. The specific field, Manufacture of furniture, is slightly above average both in employment, and wages and salaries. The

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63 Excluding furniture
employment and wages and salaries are relatively stable between 2010 and 2015, with Manufacture of furniture making significant progress in wages and salaries, making these sectors one of the most progressive ones according to the wages and salaries. The related field, Manufacture of paper and paper products, is an average employer with below average wages and salaries; however, it progressed significantly between 2010 and 2015. However, these sectors are rather insignificant according to revenues, only Manufacture of furniture captures slightly more than 1% of total regional revenues (see Error! Reference source not found.).

Construction of buildings is an important sector responsible for more than 7% of regional turnover. The key player is UNIBEP, the fourth biggest company in the region. Between 2011 and 2018, the construction sector almost doubled when there were 54 companies active in this sector (see Error! Reference source not found.). UNIBEP itself represents more than 3% of the regional turnover and has been steadily growing (Error! Reference source not found. in Annexes). There is also a company Padma, which manufactures wooden frameworks for the construction sector; it is the second biggest company with more than 20% growth in the last three years.

Manufacture of machinery and equipment, specifically agricultural machines and automotive, is another notable economic field in Podlaskie. Manufacture of machinery and equipment is one of the biggest employers; compared to Poland, it employs approximately twice that many employees. The wages and salaries are, however, below average when compared to the Polish average. The development between 2010 and 2015 is quite favourable, both employment, and wages and salaries have been increasing significantly.

Manufacture of motor vehicles, dominated by one company (LOHR Polska focusing on manufacturing of semi-trailers and automotive parts), has been the most dynamically growing sector (Error! Reference source not found. in Annexes). The automotive sector is reflected also in the sector Sale of motor vehicles, which corresponds with 2% of total regional revenues. In the top 20 economic sectors according to the turnover, Manufacture of agricultural and forestry machinery captures approximately 2%. There are four companies in Podlaskie in this field, the biggest being Pronar64 (see Error! Reference source not found. in Annexes). Pronar manufactures tractors and other agricultural machines, forestry machines, and municipal machinery (sweepers, mulchers, spreaders, snowblowers, etc.).

**Patenting activity**

Companies from manufacturing of machinery and equipment are quite active in protecting their intellectual property through patenting. One of them is the aforementioned Pronar manufacturing agricultural and forestry machinery with 21 patents. Another company with more than five patents in this economic field is Jazon (Manufacture of other special-purpose machinery). There are several companies in this field with specific specialization in engines, pumps, and turbines: AC, LPGTECH, Alex, and Europegas, all of them providing for the automotive sector. See Table 13**Error! Reference source not found.** for top patent applicants by companies.

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64 [http://pronar.pl/en/]
Table 13. Top patent applicants by companies in Podlaskie in 2018

<table>
<thead>
<tr>
<th>Company</th>
<th>Technology specialization</th>
<th>NACE dig.4</th>
<th>Turnover in thousands EUR</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHM SP. Z O.O.</td>
<td>Medical technology</td>
<td>Manufacture of medical and dental instruments and supplies</td>
<td>13 084</td>
<td>27</td>
</tr>
<tr>
<td>PRONAR SP. Z O.O.</td>
<td>Other special machines</td>
<td>Manufacture of agricultural and forestry machinery</td>
<td>115 864</td>
<td>21</td>
</tr>
<tr>
<td>MASTERPRESS S.A.</td>
<td>Handling</td>
<td>Other printing</td>
<td>32 585</td>
<td>16</td>
</tr>
<tr>
<td>INNOVATOR SP. Z O.O. S.K.A.</td>
<td>Materials, metallurgy</td>
<td>Construction of other civil engineering projects n.e.c.</td>
<td>1 532</td>
<td>15</td>
</tr>
<tr>
<td>KAN SP. Z O.O.</td>
<td>Mechanical elements</td>
<td>Manufacture of builders’ ware of plastic</td>
<td>62 783</td>
<td>14</td>
</tr>
<tr>
<td>JAZON SP. Z O.O.</td>
<td>Handling; Civil engineering</td>
<td>Manufacture of other special-purpose machinery n.e.c.</td>
<td>3 768</td>
<td>11</td>
</tr>
<tr>
<td>AC S.A.</td>
<td>Engines, pumps, turbines</td>
<td>Manufacture of electrical and electronic equipment for motor vehicles</td>
<td>47 179</td>
<td>11</td>
</tr>
<tr>
<td>LPGTECH SP. Z O.O.</td>
<td>Engines, pumps, turbines</td>
<td>Manufacture of fluid power equipment</td>
<td>4 744</td>
<td>8</td>
</tr>
<tr>
<td>ALEX SP. Z O.O.</td>
<td>Engines, pumps, turbines</td>
<td>Wholesale trade of motor vehicle parts and accessories</td>
<td>8 827</td>
<td>7</td>
</tr>
<tr>
<td>CYNKOMET SP. Z O.O.</td>
<td>Transport; Other special machines</td>
<td>Treatment and coating of metals</td>
<td>17 765</td>
<td>5</td>
</tr>
<tr>
<td>EUROPEGAS SP. Z O.O.</td>
<td>Engines, pumps, turbines; Transport</td>
<td>Manufacture of electronic components</td>
<td>4 516</td>
<td>5</td>
</tr>
<tr>
<td>CDM SP. Z O.O.</td>
<td>Handling; Surface technology, coating</td>
<td>Manufacture of other builders’ carpentry and joinery</td>
<td>5 731</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk; Orbit by Questel, 2018; data for turnover refer to 2017 or 2016

**Engines, pump, turbines, can be considered as a specific technology field according to patent activity, representing 10% of all active patents owned by private companies in Podlaskie.** There is a big difference between this share and the average share of this technology field in Poland, where it is less than 2%. The patent portfolio of the demand-side in Podlaskie is pictured in

Figure 10. However, turnover of companies in this specific economic field is rather low (only AC having more than 10 mil. EUR in revenues).

*Figure 10. Patent technology fields with a private company applicant in Podlaskie (active patents)*
Another important sector from the patenting activity perspective is Medical technology with the highest share on the patent portfolio in Podlaskie with 14%; on average, this technology field represents only 4% of patents in the Polish demand-side portfolio. There is one important stakeholder in this technology field, ChM. ChM manufactures medical and dental instruments and supplies. It has 27 active patents, with two international patents. There are other companies with patents in Medical technology such as Medgal and Diagnosis. Even though Medical technology does not belong to the economically strongest fields, the potential for innovation is very high.

**ChM Sp. z o.o.**

ChM heavily invest into R&D, approximately 10% of the turnover. They have large R&D team (engineers) and the cooperate with doctors. ChM has its own certified laboratory.

ChM has always cooperated with universities, both within the region and elsewhere; however, there faced many barriers. They understand, as one of the few companies, the role of the university at the beginning of the research and development. University has an advantage of having time and expertise and no business/market pressure. The company can capitalize on this but needs to be ready to finalize and implement the ideas from the university. However, the university is often not focusing on the basic research but tries to finalize the ideas into products, where it often does not have competences. Bialystok Medical University mentioned ChM in the survey as their strategic business partner.

All successful cooperation was based on personal links. Personal meetings and informal activities are considered to be the most beneficial activity, which would support trust building and enhance the cooperation between the demand-side and the supply-side. For example, a business-university informal club could be established. Joint doctoral (or master) thesis are considered as good practice examples as
well, though the students need to understand the fact that they have to bring some added value to the company not vice versa.

There is one interesting company not fitting to the sectors above, Photon entertainment. This company has developed an educational robot for children. It has received several awards (such as Best product design, Best product packaging, Best Polish market implementation, Toy of the Year 2018 distinction). Moreover, it is the only demand-side stakeholder who has been granted a project by the European Commission, namely the prestigious SME instrument.

Clusters as business local innovation asset

There are several clusters in Podlaskie, the Metal Processing Cluster was mentioned as the most important during the interviews. Another relevant cluster is the Eastern Construction Cluster. Surprisingly, the food sector related clusters (Podlaskie Food Cluster and “Naturalnie z Podlasia” Food Cluster) are said to be rather inactive. On the other hand, the Metal Processing Cluster can be considered as a very good best practice example with significant regional impact. The biggest added value is in networking and trust building. There are several key regional players in the cluster, such as ChM, AC, or Pronar; the cluster has 82 members altogether. The cluster helps to enhance the cooperation within the region; the Metal Processing Cluster is said to have contributed to the increased share of the intra-regional cooperation significantly.

Technology Applied Sp. z o.o.

Technology Applied was founded in 2015 by an entrepreneur from Warsaw. The reason for relocation from Warsaw to Podlaskie were the benefits offered by the region compared to other regions. Podkarpackie and Lubuskie was considered as well, but Podlaskie offered the best conditions; the cheapest rent and the most generous de minimis support, which was useful for buying the specific equipment. They are seated in the BPN-T technology park. They are also part of the Metal Processing Cluster and were mentioned as one of the key members.

Technology Applied is a very dynamic company, they double their turnover every year and invest heavily into R&D. Roughly 20% of clients (about 450 altogether) are abroad, yet export is responsible for approximately 50% of revenues. They invest the majority of their profit back to R&D; the R&D spending has increased by more than 50% in the last two years.

The company cooperates with the Bialystok University of Technology, especially using their specialized equipment (such as X-rays). They consider timely delivery and time management in general as the biggest problem in the cooperation. They reckon that the main inhibitors of cooperation are the different

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65 https://photonrobot.com/
66 There are two more projects at the East-West Science and Technology Park in Suwalki, which is considered as a supply-side even though it is a private company
67 The name is a bit misleading; it comprises stakeholders from the manufacturing field in general, it is not limited to metal processing. The cluster should be renamed soon. Moreover, the cluster shifts its orientation towards topics such as digitization/automation, big data, and artificial intelligence.
68 For full list of clusters, see https://en.parp.gov.pl/storage/publications/pdf/20190128150014m9kdr.pdf
motivations of the business on one hand and university on the other. The universities are less motivated. Moreover, some coordination is missing. Besides expertise, skilled graduates are a problem. The Bialystok University of Technology is not internally ranked as high as other technical universities, where Technology Applied prefers to hire.

Gaps and overlaps Podlaskie

When studying the supply-side as knowledge generating subsystem and the demand-side as knowledge utilization side, it is interesting to compare the competencies of both subsystems and identify gaps and overlaps. As mentioned in the conceptual framework, there are several types of both gaps and overlaps (see Table 1). The gaps and overlaps can be pictured in a simple graph (see Table 14 Error! Reference source not found.).

Table 14. Gaps and overlaps between demand and supply-side in Podlaskie

<table>
<thead>
<tr>
<th></th>
<th>not significant in the demand-side</th>
<th>significant in the demand-side</th>
</tr>
</thead>
<tbody>
<tr>
<td>not significant in the supply-side</td>
<td>Other not mentioned elsewhere</td>
<td>- Food and agriculture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Manufacture of machinery and equipment</td>
</tr>
<tr>
<td>significant in the supply-side</td>
<td>- Pharmaceuticals</td>
<td>- Medical technology</td>
</tr>
</tbody>
</table>

Source: own construction

(i) The supply-side gap

There is one sector, which is very strong in the private sector but not matched by expertise at public research organizations, the Food and agriculture and related fields. Specifically, Manufacture of food products is the biggest employer in Podlaskie. At the same time, employment in this sector, as well as wages, are higher when compared with the Polish average. There are many huge companies, often focusing on milk production and wholesale. There is not much patenting happening in this economic sector, which might mean that the companies are not yet ready for innovation. There is not much activity in food-related topics in the supply-side. There are only some patents at the University of Bialystok in Analysis of biological materials and biotechnology and publication activity at the Medical University of Bialystok. Even though there is almost no contact between the demand-side key players and the supply-side players, there is potential for supply-side to cater for demand-side in food-related fields.

(ii) The demand-side gap

Pharmaceuticals can be considered as an economic field strong at public research organizations and not very visible in the private sector. Pharmaceuticals have a very high share in the supply-side portfolio in Podlaskie when compared with overall Polish supply-side portfolio. Moreover, there are many international patents. The main applicant is the Medical University in Bialystok. The activity in this field is apparent in the publication activity at the Medical University in Bialystok as well. However, from the
available data, there is no activity in this field in the demand-side. The supply-side thus can cater to other regions, or it is potential for academic start-ups or spin-offs.

(iii) Overlapping specializations

There is one economic field, where the expertise between companies and public research organizations can be considered as overlapping, the Manufacture of medical technology. There is strong expertise on the supply-side, especially at the Białystok Technical University of Technology and Medical University of Białystok. There is the biggest regional innovator (regarding patents), CHM, with 27 active patents, two of them international. Other important players comprise Medgal and Diagnosis. However, during the interview with CHM, it was mentioned that there is very little cooperation between the demand-side and the supply-side even though there has been a constant effort from the CHM’s side. The expertise is now being sought outside the region.

It is important to remember that gaps and overlaps of specific competencies between companies and public research organizations are influenced by the whole regional innovation system, namely by cooperation across regions. An overview of the closeness of cooperation within the region (ratio of cooperation within the region to cooperation outside of the region) can be approximated by the joint patent applications for cooperation between the supply-side and the demand-side.

The network of cooperation on patents is very sparse indicating very weak cooperation in general, joint university-business patents being very rare. The three key supply-side stakeholders (Białystok University of Technology, Medical University of Białystok, and University of Białystok) are the main hubs (nodes) within the network, yet there is a limited number of partners. On top of that, the majority of cooperation (joint patents) is with companies or research institutes outside the region. Although contractual research would be more suitable for this analysis, the co-ownership of patents shows that there is not enough demand-side capacity or will to cooperate on patent applications. The network is presented in Figure 11. The network analysis shows that there is not much joint patenting happening in Podlaskie, with the majority of joint patents within the supply-side only. The significant exception is the company Innovator (active in materials and metallurgy), which has several joint patents with the demand-side, but outside the region (in Warsaw and Gliwice). The majority of joint patents are in the field of pharmaceuticals and chemistry in general. The most significant volume of joint patents is with entities outside the Podlaskie region. The cooperation of companies in Podlaskie with supply-side stakeholders outside the region was confirmed during interviews. The most active companies in patenting, such as CHM and Pronar patent only in-house and thus do not appear in this network.

Figure 11. Network based on co-ownership of patents by Podlaskie stakeholders, 2018
The RIS3 strategy of Podlaskie region contains the following priorities:

- Medical sector, life sciences
- Eco-innovations, environmental science
- Agri-food
- Metal and machinery industry, shipbuilding

In general, the areas mentioned in the RIS3 strategy match the expertise mapped within this analysis, especially in the Gaps and overlaps section. However, there are some differences and details worth explaining. First, it is important to understand the difference between priorities and expertise identified in this analysis. Priorities are topics, which are deemed important but do not necessarily reflect the strongest current expertise within the region. The gaps and overlaps reflect the expertise and are based on empirical data, having limited relation to the importance of competitiveness of the region.
From the Gaps and overlaps analysis, there is only one priority where the overlap of expertise in business and public research organizations was identified – medical technology. There is a strong supply-side stakeholder, the Medical University in Bialystok, but the medical technology is very strong at the Bialystok University of Technology as well. Moreover, there is a relatively young stakeholder, the University of Medical Science in Bialystok. This expertise is matched by some private companies. The overlap can be found only in the manufacturing of medical technology; in other medical-related fields, there are gaps in expertise between the demand and the supply-side.

If pharmaceuticals are considered as part of the “Medical sector, life science” priority, there is a demand-side gap. There is relatively strong expertise in the supply-side sector (mainly in Medical University in Bialystok) not matched by the demand-side. However, in the context of the RIS3 strategy, the potential for start-up creation should be mentioned and supported. Based on the example of the University of Medical Science in Bialystok, where three start-ups have recently been founded, this might be an interesting option worth supporting as a way to help the region to become more competitive.

Agri-food priority is reflected in the Food and agriculture expertise, which is considered in this analysis as a supply-side gap. The food-related sectors and their value chain are, by far, the economically strongest fields in Podlaskie. There are several very strong demand-side stakeholders, especially in dairy product production and wholesale. However, the sector is fairly rigid with minimal innovation-related activities. Furthermore, it is not matched by the supply-side expertise. This might be considered an opportunity for the supply-side. There are very few activities outside the dairy products as a particular focus of the food industry in Podlaskie.

The Metal and machinery industry and shipbuilding in the RIS3 strategy were not identified as one of the key sectors in the analysis. The machinery industry has been identified as strong demand-side expertise yet missing in the supply-side. Moreover, the focus is specifically on agricultural machines with several strong players. A metal processing industry cluster represents the metal industry, but this sector is not among the leading sectors, no innovation activity has been identified in this sector either.

Eco-innovations, environmental science priority is very broad and not specified very well in the RIS3 strategy. It is based on the agricultural focus of the region, yet empirical data do not support it. This priority is more of an ambition than an existing competitive advantage. There are some specific supply-side stakeholders. There is potential to innovate the business, even though it is rather rigid and this priority needs to be understood as long-term potential.

It would be useful to start supporting technology transfer in fields and areas, where there is an overlap of expertise between businesses and universities or in areas with high potential, such as in medical technology manufacturing and the food-related fields. Higher potential for technology transfer is in pharmaceuticals; yet in this case, the focus would have to be given to start-up or spin-off creation since the demand-side is weak within this domain.

The university-business cooperation within the region could be explicitly encouraged. The network analysis suggested very few links and cooperation with stakeholders from different regions. The weak links were confirmed during the interviews within the region. The visibility of CTTs should be increased.
At the same time, the importance of innovation and the role of universities and research institutions for private companies should be explained. In general, the whole eco-system is rather immature and needs to be cultivated.
Walbrzych sub-region

Benchmarking Lower Silesia

The Regional Innovation Scoreboard ranks Lower Silesia as a Moderate – Innovator, demonstrating improved innovation performance over time. It shows relative strengths in design applications, employment in MHT manufacturing and knowledge-intensive services (KIS), and export of MHT manufacturing. The biggest relative weaknesses (compared to the EU28) are in European patent applications and innovative SMEs collaborating. There are some structural differences when compared with Poland as a whole and the EU28. The share of employment in manufacturing is significantly higher than on average in Poland and EU28. The economic (GDP and unemployment) and R&D (employment and shares of different sectors) regional characteristics for Lower Silesia and peer regions are summarized in Table 15.

Table 15. Economic and R&D characteristics in Lower Silesia and peer regions in 2016

<table>
<thead>
<tr>
<th>Region</th>
<th>GDP (PPS per inhabitant) 2016</th>
<th>R&amp;D expenditure (GERD) in % of GDP 2015</th>
<th>Employment in R&amp;D (%) 2015</th>
<th>R&amp;D expenditures, sectoral share in % 2015</th>
<th>Unempl. rate 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU 28</td>
<td>29 200</td>
<td>2,04</td>
<td>1,34</td>
<td>55</td>
<td>13</td>
</tr>
<tr>
<td>Midi-Pyrénées (FR)</td>
<td>27 900</td>
<td>4,75</td>
<td>2,49</td>
<td>66</td>
<td>12</td>
</tr>
<tr>
<td>Jihovýchod (CZ)</td>
<td>23 600</td>
<td>2,83</td>
<td>1,74</td>
<td>59</td>
<td>12</td>
</tr>
<tr>
<td>Dolnoslaskie (PL)</td>
<td>22 100</td>
<td>0,85</td>
<td>0,81</td>
<td>37</td>
<td>10</td>
</tr>
<tr>
<td>Wielkopolskie (PL)</td>
<td>21 700</td>
<td>0,74</td>
<td>0,59</td>
<td>40</td>
<td>19</td>
</tr>
<tr>
<td>Lubuskie (PL)</td>
<td>16 700</td>
<td>0,22</td>
<td>0,22</td>
<td>31</td>
<td>-</td>
</tr>
<tr>
<td>Opolskie (PL)</td>
<td>15 900</td>
<td>0,32</td>
<td>0,30</td>
<td>28</td>
<td>17</td>
</tr>
<tr>
<td>Nord-Vest (RO)</td>
<td>14 900</td>
<td>0,41</td>
<td>0,18</td>
<td>22</td>
<td>36</td>
</tr>
<tr>
<td>Sud-Est (RO)</td>
<td>14 500</td>
<td>0,08</td>
<td>0,10</td>
<td>16</td>
<td>57</td>
</tr>
<tr>
<td>Dél-Alföld (HU)</td>
<td>14 000</td>
<td>1,69</td>
<td>0,59</td>
<td>38</td>
<td>17</td>
</tr>
<tr>
<td>Sud - Muntenia (RO)</td>
<td>13 400</td>
<td>0,34</td>
<td>0,19</td>
<td>67</td>
<td>24</td>
</tr>
<tr>
<td>Észak-Magyarország (HU)</td>
<td>13 000</td>
<td>1,1</td>
<td>0,27</td>
<td>63</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Eurostat; Polish statistical office; 2018; data for French regions in 2013

According to economic characteristics, Lower Silesia is doing well, and its situation has been further improving. Lower Silesia has considerably high GDP per capita in 2016, on 75% of the EU28 mean. Lower
Silesia has higher GDP per capita than all structural and Regional peers. Aspirational leaders are ahead but not very far, and the gap between Lower Silesia and Jihovýchod and Midi-Pyrénées has been closing. The unemployment rate is quite low even though it was significantly higher at the beginning of the decade. The levels of unemployment are relatively low in the whole EU. Lower Silesia is one of the regions with the highest wages and salaries in Poland. It is one of the two regions (together with Mazowieckie, which has 122% of the Polish average) with above-average wages and salaries. The regional peers are significantly worse off, even though the wages and salaries are, in general, very similar within Poland, for all figures see Error! Reference source not found. in Annexes.

However, there are big differences between Lower Silesia’s average figures and figures in Walbrzych sub-regions, which is lagging. The Walbrzych sub-region had 89% of the Polish average in wages and salaries in 2017. The gap is moderately decreasing; the Walbrzych sub-region had 88% of the Polish average in 2015. The Walbrzych sub-region creates approximately 15% of Lower Silesia absolute GDP and has 66% of the voivodship GDP per capita in 2015 (74% of Polish GDP per capita). In the last ten years, the highest unemployment in the region was in 2012, when it was 21% (in Poland in 2012 it was 13%). Since 2012, the unemployment rate has been decreasing, reaching 9% in 2017 (6.5% in Poland).

Even with quite favourable economic conditions, Lower Silesia has fairly low intramural R&D expenditures (slightly below Polish average). It has been increasing since 2011, and it is higher than regional and structural peers except Hungarian regions. It still lags behind when compared to aspirational peers and the EU28 mean in general, which is roughly 2% of GDP. Aspirational leaders have higher R&D expenditures than is the EU28 mean, especially Midi-Pyrénées with 4.5%. See Figure 15 in Annexes for details. The R&D expenditures are, to some extent, influenced by the structure of employment in R&D by sectors (high education sector, business sector, government sector). In Lower Silesia, the share of the business sector is 37%, which is slightly higher than Opolskie as a regional peer (28%) and slightly lower than another regional peer, Wielkopolskie (40%). The figures are slightly higher in the case of Hungarian structural peers and significantly lower in the case of Romanian structural peers. The aspirational peers, Jihovýchod and Midi-Pyrénées, are far ahead with 66% and 59% respectively in the business sector. The results are pictured in Figure 16 in Annexes.

Lower Silesia is moderately active in domestic patenting with a stable number of registered patents in the last decade. The number of registered European patents has significantly increased. Registered intellectual property is an important indicator for innovation potential of the region. Lower Silesia is the third most active region within Poland in patenting with 9% share of the total number of patents. Only Mazowieckie and Malopolskie have higher shares (12% and 10% respectively), all regional peers are behind Lower Silesia (Opolskie 6%, Lubuskie 2%, and Wielkopolskie 7%). The total number of patents granted in 2017 according to regions can be found in Figure 17 in Annexes. Lower Silesia is doing better than the majority of structural peers but significantly worse than aspirational peers in registered European patents.

70 Normalized by population
71 Patents are attributed to regions according the residency of the applicant. When there are applicants from two or more different regions, the patent is split equivalently between those regions. The absolute numbers were normalized according to population (per million inhabitants).
The patent activity in Lower Silesia (there are 11 European patents per million inhabitants in Lower Silesia) is approximately three times lower than in Jihovýchod in Czechia (27) and nine times lower than in Midi-Pyrénées in France (95). From regional peers, Lower Silesia is doing slightly better than Opolskie (9) and Wielkopolskie (8); it is behind Lubuskie (16). The structural peers are far behind Lodzkie except Dél-Alföld (16). Lower Silesia has significantly improved between 2008 and 2012 (the number has more than doubled). Walbrzych sub-region within Lower Silesia has approximately 5 European patents per million inhabitants, while this number has risen since 2008 four times.

Supply-side Walbrzych (Lower Silesia)

The goal of the supply-side analysis is to identify strong regional competencies in the knowledge generation subsystem, which might be used for the development of the region. The competencies identified in the supply-side are later compared with competencies identified in the demand-side and gaps and overlaps between these competencies are uncovered. Besides the identification of key technology fields and specific competencies, the key stakeholders are identified.

There are not many supply-side institutions in Walbrzych sub-region, the majority of notable universities and research organizations are in Wroclaw. Due to the size of the Walbrzych sub-region and typical size of the technology transfer ecosystem, institutions from the whole Lower Silesia voivodship are considered as part of the supply-side for the Walbrzych sub-region. Nevertheless, there are some notable supply-side institutions in Walbrzych sub-region as well, typically organizational units of universities from Wroclaw or elsewhere, such as Space Research Centre of Polish Academy of Sciences (seated in Warsaw), branch of Wroclaw University of Technology, and the University of Casimir the Great in Bydgoszcz – Didactic Center in Wałbrzych. However, these institutions generate very limited number of outcomes from the technology transfer perspective.

Patenting activity

The first technology field that stands out in the Lower Silesia at universities and research organizations is Organic fine chemistry. It has a 23% share on the patent portfolio (see Figure 12), compared to the national average of only 8% (although it is the second biggest technology field after Measurement). However, the majority of patents in the Organic fine chemistry field are domestic patents, only two patents are international. Organic fine chemistry is not that visible in other indicators; however, it is the most common publication topic at the biggest university in the region, the University of Wroclaw, capturing more than 15% of all publications. The University of Wroclaw, Wroclaw University of Technology, and the Wroclaw University of Environmental and Life Sciences are the key players behind the chemistry related topics. The latter two are dominant in patenting, together having more than 450 patents in Organic fine chemistry. This topic is also quite common in their publications.

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72 https://ec.europa.eu/eurostat/data/database; the results are not fully comparable with the data from Poland. In Poland all patents were considered, in this case only European patents. The most recent year available in Eurostat database is 2012. The number of European patents is normalized by population.

73 Altogether, there are 2118 active patents with supply-side applicants from Lower Silesia voivodship.
Pharmaceuticals and biotechnology are two other important technology fields in Lower Silesia when expertise at public research organizations is considered. The Pharmaceuticals technology field has 13% share on the patent portfolio, biotechnology 7% (see Figure 12). On average, the pharmaceuticals technology field has 6%, and biotechnology has 3% in Polish patent portfolio. In biotechnology, the majority of these patents are Polish, only 7% are international (11 out of 156). In pharmaceutical, where patenting is especially important, the share of the international patent is significantly higher, almost 20% (55 out of 289). Thus, the pharmaceuticals technology field, specifically, yields high potential for technology transfer in Lower Silesia supply-side.

There are two specific institutions with the majority of patents in pharmaceuticals and biotechnology, the Wroclaw Research Center EIT + and Institute of Immunology and Experimental Therapy of Polish Academy of Sciences. However, in absolute terms, Wroclaw University of Science and Technology, Wroclaw University of Environmental and Life Sciences, and Wroclaw Medical University still have more patents in these technology fields. The patent portfolio of the Lower Silesia region, arranged according to patent owners, is shown in Table 16.

Table 16. List of key supply-side stakeholders in the Lower Silesia region, active patents

<table>
<thead>
<tr>
<th>R&amp;D institution</th>
<th>Specialization</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wroclaw University of Science and Technology</td>
<td>Organic fine chemistry (262); Measurement (118); Pharmaceuticals (73); Medical technology (65); Engines, pumps, turbines (63); Macromolecular chemistry, polymers (53); Biotechnology (52); Chemical engineering (52)</td>
<td>1 190</td>
</tr>
<tr>
<td>Wroclaw University of Environmental and Life Sciences</td>
<td>Organic fine chemistry (189); Biotechnology (71); Pharmaceuticals (58); Food chemistry (35); Basic materials chemistry (32)</td>
<td>433</td>
</tr>
<tr>
<td>University of Wroclaw</td>
<td>Basic materials chemistry (27); Pharmaceuticals (21); Materials, metallurgy (17)</td>
<td>126</td>
</tr>
<tr>
<td>Wroclaw Medical University</td>
<td>Pharmaceuticals (60); Medical technology (26)</td>
<td>116</td>
</tr>
</tbody>
</table>
European research projects

**A specific sub-field not directly visible in the aggregated data is the focus on nanomaterials.** It is partly observable in the topics of European research and application projects. The list of the most active participant in European research and application projects are listed in [Error! Reference source not found.](#). The Wroclaw University of Technology is by far the most active in European projects; it has almost 7 million EUR on European Commission contribution. There are many projects with a focus on nanomaterials. Moreover, when the patent portfolio is studied in detail, there are many patents related to nanomaterials in different technology fields. There are roughly twice as many patents in different fields related to nano-sciences than in Micro-structural and nano-technology technology fields.

**Rankings and publication activity**

**Wroclaw University of Science and Technology, University of Wroclaw, and Institute of Immunology and Experimental Therapy of Polish Academy of Sciences can be considered the most excellent and important supply-side stakeholders in Lower Silesia.** First, the Wroclaw University of Science and Technology is ranked 6th according to Polish Perspektywy University Ranking and 11th in the Scimago composite ranking (second best technical university and third best university in Poland). The University of Wroclaw has been awarded a 14th place in Scimago ranking and 8th in Perspektywy University Ranking. After these two most excellent universities, the Wroclaw Medical University (12th in Perspektywy University Ranking and 28th in Scimago ranking) and Wroclaw University of Environmental and Life Sciences (34th in Perspektywy University Ranking and 43rd in Scimago ranking), follow. Moreover, Institute of Immunology and Experimental Therapy of Polish Academy of Sciences is ranked the 6th most institution in Poland. Wroclaw Research Center EIT + is also an important supply-side stakeholder in the region.

**It is important to bear in mind that a limited number of indicators (patents, European projects, publications), which cannot fully capture the specialization of public research organizations, was used.** However, these indicators should provide relatively good information about regional specializations. Importantly, to understand the environment more in depth, it is necessary not only to look at the

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74 Specific field related to nano-sciences, Micro-structural and nano-technology, is relatively new technology field and increase of patenting within this field can be expected.

75 [http://www.ranking.perspektywy.org](http://www.ranking.perspektywy.org)


77 Perspektywy University Ranking does not include governmental institutions such as the Polish academy of Sciences.
quantitative data but to speak with the key stakeholders. Thus, the quantitative data has been complemented by information gathered during interviews with the key stakeholders.

Supporting infrastructure

Dolnoslaski Park Technologiczny (T-park)\(^\text{78}\) is the only representative of the infrastructure supporting the university-business cooperation and entrepreneurship. During the interview in the park, it was mentioned that they are aware of the low level of cooperation between the supply-side and the demand-side; they reckon that “the main barrier is at the side of universities, which are not ready for cooperation, especially due to unclear processes and bureaucracy,” (interview with management, 21.11.2018). The park offers many activities supporting the entrepreneurial spirit, such as “Future-preneurs” program supporting start-ups creation (with special attention to IT and cleantech sectors). They offer innovation vouchers (simple innovation projects for companies in partnership with universities). However, none of the interviewed companies knew about this possibility. T-park has a cooperation with a VC fund focusing on cleantech and smart city. The park supports the idea of the challenge-driven university.

Demand-side Walbrzych

Economic output and economic growth

The most visible economic field in Walbrzych sub-region is the automotive field and sectors related to the automotive field through value chains. First, it is by far the largest economic field according to revenues. The 20 largest economic fields are captured in Table 17 Error! Reference source not found.. The Manufacture of parts and accessories for motor vehicles and the Manufacture of motor vehicles fields together can be attributed more than one-third of all revenues in the sub-region. Moreover, there is a strong field of railway locomotives and rolling stock in fifth place according to the revenues.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of parts and accessories for motor vehicles</td>
<td>12</td>
<td>1 439 128</td>
<td>996 146</td>
<td>144</td>
<td>24,8</td>
<td>24,8</td>
</tr>
<tr>
<td>Manufacture of motor vehicles</td>
<td>1</td>
<td>583 987</td>
<td>562 171</td>
<td>104</td>
<td>10,0</td>
<td>34,8</td>
</tr>
<tr>
<td>Other specialized wholesale</td>
<td>40</td>
<td>242 032</td>
<td>213 538</td>
<td>113</td>
<td>4,2</td>
<td>39,0</td>
</tr>
<tr>
<td>Manufacture of electric motors, generators, transformers and electricity distribution and control apparatus</td>
<td>6</td>
<td>174 258</td>
<td>157 483</td>
<td>111</td>
<td>3,0</td>
<td>42,0</td>
</tr>
<tr>
<td>Manufacture of railway locomotives and rolling stock</td>
<td>2</td>
<td>172 304</td>
<td>114 126</td>
<td>151</td>
<td>3,0</td>
<td>44,9</td>
</tr>
<tr>
<td>Wholesale of food, beverages and tobacco</td>
<td>18</td>
<td>141 608</td>
<td>105 737</td>
<td>134</td>
<td>2,4</td>
<td>47,4</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>14</td>
<td>115 500</td>
<td>68 480</td>
<td>169</td>
<td>2,0</td>
<td>49,4</td>
</tr>
</tbody>
</table>

\(^\text{78}\) [http://www.darr.pl/pl/park-technologiczny-t-park](http://www.darr.pl/pl/park-technologiczny-t-park)
Manufacture of other general-purpose machinery | 4 | 106 131 | 86 281 | 123 | 1,8 | 51,2

Total | 5 811 952 | 4 439 164 | 131

Source: Amadeus by Moody’s Analytics / Bureau van Dijk, 2018; note: NACE Revision 2 dig.3 used; Index is counted as operating revenues from 2016–2017 divided by operating revenue from 2012–2011; total included values by all economic fields

Toyota motor manufacturing Polska, Faurecia Walbrzych, and Ronal Polska are the three biggest companies according to turnover, all three from the automotive sector. These three companies are responsible for more than 25% of the total turnover of the companies seated in the region (see Table 18).

Table 18. The companies with the biggest revenues in Walbrzych region in 2017/2016

<table>
<thead>
<tr>
<th>Company name</th>
<th>NACE dig.2</th>
<th>NACE dig.4</th>
<th>Turnover in thous. EUR</th>
<th>T1 in %</th>
<th>T2 in %</th>
<th>T3 in %</th>
<th>%</th>
<th>Cumul. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOYOTA MOTOR MANUFACTURING POLAND SP. Z O.O.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of motor vehicles</td>
<td>583 987</td>
<td>131</td>
<td>97</td>
<td>104</td>
<td>10,0</td>
<td>10,0</td>
</tr>
<tr>
<td>FAURECIA WALBRZYCH S.A.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>509 633</td>
<td>110</td>
<td>99</td>
<td>113</td>
<td>8,8</td>
<td>18,8</td>
</tr>
<tr>
<td>RONAL - POLSKA SP. Z O.O.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>401 649</td>
<td>107</td>
<td>107</td>
<td>120</td>
<td>6,9</td>
<td>25,7</td>
</tr>
<tr>
<td>NSK STEERING SYSTEMS EUROPE (POLSKA) SP. Z O.O.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>237 631</td>
<td>114</td>
<td>106</td>
<td>92</td>
<td>4,1</td>
<td>29,8</td>
</tr>
<tr>
<td>WAGONY ŚWIDNICA SP. Z O.O.</td>
<td>Manufacture of other transport equipment</td>
<td>Manufacture of railway locomotives and rolling stock</td>
<td>171 183</td>
<td>168</td>
<td>87</td>
<td>123</td>
<td>2,9</td>
<td>32,8</td>
</tr>
<tr>
<td>MANDO CORPORATION POLAND SP. Z O.O.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>104 227</td>
<td>150</td>
<td>187</td>
<td>225</td>
<td>1,8</td>
<td>34,6</td>
</tr>
<tr>
<td>LEGRAND POLSKA SP. Z O.O.</td>
<td>Manufacture of electrical equipment</td>
<td>Manufacture of electricity distribution and control apparatus</td>
<td>92 486</td>
<td>91</td>
<td>104</td>
<td>95</td>
<td>1,6</td>
<td>36,1</td>
</tr>
<tr>
<td>BEL - POL SP. Z O.O.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of wood, construction materials and sanitary equipment</td>
<td>75 754</td>
<td>112</td>
<td>113</td>
<td>107</td>
<td>1,3</td>
<td>37,4</td>
</tr>
<tr>
<td>LINCOLN ELECTRIC BESTER SP. Z O.O.</td>
<td>Manufacture of electrical equipment</td>
<td>Manufacture of other electrical equipment</td>
<td>65 236</td>
<td>99</td>
<td>95</td>
<td>101</td>
<td>1,1</td>
<td>38,6</td>
</tr>
<tr>
<td>GE POWER CONTROLS POLSKA SP. Z O.O.</td>
<td>Manufacture of electrical equipment</td>
<td>Manufacture of electricity distribution and control apparatus</td>
<td>64 419</td>
<td>84</td>
<td>111</td>
<td>104</td>
<td>1,1</td>
<td>39,7</td>
</tr>
<tr>
<td>ORION PU SP. Z O.O.</td>
<td>Manufacture of chemicals and chemical products</td>
<td>Manufacture of paints, varnishes and similar coatings, printing ink and mastics</td>
<td>58 475</td>
<td>69</td>
<td>92</td>
<td>112</td>
<td>1,0</td>
<td>40,7</td>
</tr>
<tr>
<td>COLGATE-PALMOLIVE MANUFACTURING (POLAND) SP. Z O.O.</td>
<td>Manufacture of chemicals and chemical products</td>
<td>Manufacture of perfumes and toilet preparations</td>
<td>56 876</td>
<td>111</td>
<td>107</td>
<td>100</td>
<td>1,0</td>
<td>41,7</td>
</tr>
<tr>
<td>TOTAL</td>
<td>5 811 952</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>100,0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk, 2018; % means share on the whole economy in turnover; n. a=not available; data for turnover refer to 2017 or 2016; T1, T2, and T3 stand for turnover in % compared with the previous year, T1 corresponds with the last available year.
The dominance of automotive and transport related fields is visible from the patent portfolio as well. The share of the technology fields Transport and Mechanical elements on the Walbrzych sub-region patent portfolio is significantly higher when compared with average Polish figures. There are 19% patents in Transport and 10% patents in Mechanical elements in Walbrzych country; on average in Poland, it is 6% patents in Transport and 3% in mechanical elements. Approximately 10% of these patents are international (European, 2 out of 18). The Walbrzych demand-side patent portfolio is pictured in Figure 13. Also, the Civil engineering technology field has a bigger share on the patent portfolio in Walbrzych compared to Poland, 21% in Walbrzych and 16% in Poland.

Patenting activity

Two private companies stand out in the patent activity, Capricorn with 21 patents in Civil engineering and Mechanical elements, and Wagony Swidnica with nine patents in Manufacture of railway locomotives and rolling stock. While Capricorn has only Polish patents, Wagony Swidnica has two European patents as well. The list of the most active companies in patenting is captured in Error! Reference source not found. in Annexes. However, one must take into account the limited number of patents owned by demand-side stakeholders – as of October 2018; there are only 65 active patents.

Wagony Swidnica Sp. z o.o.

Wagony Swidnica’ core business is a wagon production. Wagony Swidnica functions as the main production plant and R&D centre for the Greenbrier in Europe. Majority of manufactured wagons are tailored made, which is the main competitive advantage of the company. The joint venture with the US company Greenbrier, a global leader, is an important milestone in the last decade. Recently, Wagony Swidnica added another significant wagon manufacturer, Astra (based in Arad in Romania) to its portfolio.

The company has approximately 30% share of the European market and caters especially for developed Western markets. They invest tens of millions of Euros yearly to R&D. The majority of production is exported (especially to Germany, France, and Italy) Their R&D department is the biggest one in Europe in the field of wagon manufacture. Moreover, R&D in Arad (Romania) and Poprad (Slovakia) is managed from Swidnica as well.

Wagony Swidnica cooperates especially with external companies and clients. From universities, it cooperates with the Technical University in Wroclaw and Technical University in Krakow. The main reason for cooperation is the equipment and know-how the company lacks. However, the cooperation is usually only on analysis without R&D itself. Like other companies, Wagony Swidnica feels that universities lack knowledge about the market, which they consider necessary for a high-quality delivery. Furthermore, the company considers its internal team well qualified and it is not motivated to cooperate with universities. The potential for cooperation with universities is not only in developing the wagons (which is obviously stronger in-house), but in fields related to industry 4.0, where the company is not that strong.

Figure 13 Patent portfolio of the demand-side in Walbrzych sub-region (active patents)
There are other interesting fields, but not as dominant as automotive and transport related fields; the plastic products field is one of them. It is one of the biggest fields according to the turnover (almost 3% of the total turnover, see Error! Reference source not found.) with 14 companies seated in the Walbrzych region. Moreover, there has been a significant growth lately (see Error! Reference source not found. in Annexes). There are, however, no patents in the related technology field.

The chemical industry can also be considered as a regional specialization, specifically the Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms. There are only three companies, but their turnover is almost 80 mil. EUR (almost 1,5% of the total turnover). Moreover, the whole field has tripled (according to the turnover) in the last five years. There are two big companies in this field, Orion PU and Colgate-Palmolive Manufacturing Poland.

Clusters as business local innovation asset

There are not many clusters active in the Lower Silesia; those present are said to have very limited impact. There is Nutribomed cluster focusing on biopharmaceuticals and food technology and Centre for Energy Technology Cluster. The latter one is based in Swidnica in Walbrzych sub-region, but the activity is very limited.

Gaps and overlaps Walbrzych (Lower Silesia)

When studying the supply-side as a knowledge-generating subsystem and the demand-side as knowledge utilization subsystem, it is interesting to compare the competencies of both subsystems and identify gaps and overlaps. As mentioned in the conceptual framework, there are several types of both gaps and overlaps (see Table 1Error! Reference source not found.). The gaps and overlaps can be pictured in a simple graph.
Table 19. Gaps and overlaps between demand and supply-side in Walbrzych sub-region

<table>
<thead>
<tr>
<th>Relatively unimportant in demand-side</th>
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<td>Relatively important in supply-side</td>
<td>- Pharmaceuticals and biotechnology</td>
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Source: own construction

(i) The supply-side gap

There is one important supply-side gap – the automotive industry and other transport manufacturing. Walbrzych sub-region has a very strong specialization in the automotive field with several companies from the automotive value chain, dominated by Toyota. The Automotive field is dominant, especially when the turnover is considered. This demand-side specialization is not matched at all by the supply-side specialization, which might be due to weak links between the demand-side and the supply-side since this specialization is rather new to the region. Furthermore, it is often low-skilled manufacturing with limited potential for innovation and technology transfer within the region. However, as examples from other countries show, there is a potential for industrial upgrading. Manufacturing of rail railway locomotives and rolling stock can also be considered as a specific supply-side gap related to transport manufacturing. There is a good potential for the supply-side to cater to the strong demand-side.

The second field considered as a supply-side gap is Civil engineering. There is higher patenting activity than on the national average, mainly thanks to the company Capricorn with more than 20 active patents. On the supply-side, the innovation activity in Civil engineering is rather low. The patent activity is slightly lower than the Polish average. Similarly, in publication activity, the key supply-side stakeholders are more active in different fields.

(ii) The demand-side gap

Pharmaceuticals and biotechnology can be considered as a demand-side gap. There is strong research in several supply-side institutions. There are specific stakeholders such as Wroclaw Research Institute EIT + or the Institute of Immunology and Experimental Therapy of Polish Academy of Sciences. Pharmaceutical and biotechnology are very strong at the Wroclaw University of Science and Technology and the Wroclaw University of Environmental and Life Sciences as well. Due to the position of the Walbrzych sub-region, it is rather improbable that the supply-side would transform the economic structure of the region and there is quite a low probability of successful technology transfer in these fields. The only exception might be in spin-outting the academic research and building a new business.

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79 Pavlinek and Ženka, 2010
(iii) Overlapping specializations

There is an overlap of specialization of businesses and public research organizations in the broad field of chemistry. There is a lot of activity in patenting in the Organic fine chemistry technology field, which has a significantly higher share on the patent portfolio when compared to the share in the Polish portfolio in general. It is the strongest technology field in the patent portfolio of the Wroclaw University of Science and Technology, the Wroclaw University of Environmental and Life Sciences, University of Wroclaw, and Institute of Low Temperature and Structure Research of Polish Academy of Sciences. All these stakeholders are very active in publications as well. There is an overlap in the demand-side, even though it is not a big one. The chemistry field is moderately big, but it has been growing in the last years. There are two big companies in this field. One of these companies is the Selena company, which is the global leader in the production of (polyurethane) foams for construction. This company has a global R&D centre in Dzierżoniów in Walbrzych sub-region. It occasionally cooperates with Wroclaw University of Science and Technology on a simple task, like measurements or partial analyses. None of the companies in Walbrzych sub-region participated in a European research and application project; none of them have joint ownership on a patent.

Selena S.A. (Orion Sp. z o.o.)

Selena, together with Belgian company Soudal, is the world’s largest insulating foam producer, holding approximately 10% of the world market. The company was founded in Dzierzoniow 20 years ago. One of the reasons to establish the company in Dzierzoniow was the benefits offered by a then newly established industrial economic zone introduced by the City of Dzierzoniow.

There is an R&D centre in Dzierzoniów for the whole Selena group, even though the headquarters is in Wroclaw. The group consists of many companies in the construction chemistry sector (the group includes companies such as Orion or Libra). The company sells its products mainly on the Eastern markets, especially in the countries of the former USSR. Export is responsible for 60% of revenues.

The company cooperates with the Technical University in Wroclaw; similarly to other companies from the region, the majority of the cooperation is in routine measurements and testing. Universities typically capitalize on the investments into the highly specialized equipment, which is too expensive (both in terms of the equipment as such and in terms of having specialized expert in house) for the company. Selena group tries to cooperate with universities on research projects as well. However, they feel that universities have limited practical experience and their results are too “academic” with no relation to the market. Moreover, the company would welcome managerial positions are universities, who would be able to supervise or manage the cooperation. In addition, they would prefer if the remuneration of the cooperation could be linked to the quality of the work delivered.

One has to bear in mind that specialization gaps and overlaps between companies and public research organizations are influenced by the whole regional innovation system, namely by cooperation between the demand-side and the supply-side across regions. An overview of the closeness of cooperation within the region (ratio of cooperation within the region to cooperation outside the region) can be approximated by the joint patent applications for cooperation between the supply-side and the demand-side. However,
none of the companies in Walbrzych has joint ownership of a patent with a supply-side stakeholder. None of the companies has had a European research and application project either. In the case of Walbrzych sub-region, it is necessary to consider the fact, that there is a very limited number of supply-side stakeholders directly in the Walbrzych sub-region. Thus, the whole Lower Silesia has been considered a supply-side for the companies in Walbrzych sub-region. Hence there are limits for the technology transfer.

The lower level of cooperation may be caused by a combination of lack of trust and by different levels of knowledge. One of the companies interviewed said: “We would like to cooperate with the university on the development of our new products, but their knowledge in our field is 20 years old” (interviewed company, 15. 11. 2018). Another company mentioned trust as a big barrier for deeper cooperation: “We had cooperation with one researcher from a university on the development of a new product, but he published our secret research in an academic journal, and we lost the right to patent the technology. We burned money and time and lost the trust in cooperation with academia completely.” (interviewed company, 21. 11. 2018).
Practical Recommendations

In all three regions, public research institutions could improve the breadth and depth of technology transfer to the commercial sector and better integrated into the local economy. On both the supply and the demand sides, the needs of “the other” are yet to be realized. Thus, there are tremendous opportunities for scaling, bridging, communicating, and building capabilities and local networks for relevant and effective collaborations between PROs and local entrepreneurs, firms and industries.

This report highlights five key areas for recommended actions:

- Build and upgrade capabilities of the supply-side,
- improve linkages and flow of information,
- improve the effectiveness and targeting of the existing policy mix,
- align supply-side capabilities to the demand-side (research relevance),
- and address complementarities within the entrepreneurial ecosystem.

Within each of these areas, there are several proposed actions and proposals for the regional stakeholders to consider and adopt. The proposals were selected to strictly meet a set of principles:

- **Grounded**: in the analytical findings that emerged from the data and field work and address identified gaps and potentials within the supply and demand framework.
- **Designed for Piloting**: experimental in nature and tend to be implemented on the short term. If the pilot fails to achieve its objectives, it is supposed be adjusted, refocused, or terminated. This necessitates the introduction of a clear monitoring and evaluation mechanism which would allow for such decision making.
- **Low cost**: do not require substantial budget commitment but leverage resources from regional and national private and public stakeholders.
- **Easy to implement**: the suggested pilots don’t require complicated administrative procedures, institutional and governance structures. On the contrary, they are expected to leverage existing structures, institutions, and the capabilities of teams already running or overseeing related activities. Thus, with little capacity building could be embedder into existing mechanisms.

The objectives of the pilots are briefly described here within each of the key areas. However, a more detailed description of a subset of these initiatives will be presented to the regional stakeholders based on further consultation within the regions. A separate document titled “Suggested Pilots for Better Results” will articulate the value proposition and attributes of the suggested pilots within each region. The final shape, nature, and scope of these pilots will depend on the buy in from the counterparts in the regions. The list of the emerging areas for recommended actions is summarized in the Figure 14.

*Figure 14. Structured list of emerging practical recommendations*
### Building capabilities of the supply-side

- **Upgrade the capacity of researcher teams and technology transfer intermediaries for effective commercialization of research.** Introduce programs for building these skills. Business skills at universities need to be enhanced. The CTTs and SPCs (in all three regions) do not have all necessary skills for effective technology transfer. As the examples elsewhere show, and the TTO survey corroborates the focus should be given to practical skills such as patent valuation, assessing technology strengths, negotiating with business etc. However, this capacity building will not be limited to CTT business experts, researchers will be addressed as well. Improving their business skill will enable them to shape their research for wider impact. Include especially topics such as research commercialization, market research, human centred design, and communication and negotiation with businesses.

- **Introduce structured mechanisms for cooperation between local businesses and academia.** In regions where the research capacity does not meet the business demand, focus of involving students in business-led challenges and cooperation. Allowing students to participate in problem solving for real business challenges achieves a dual objective of practical training for the students and access to much needed technical talent for the businesses. Such mechanism has been introduced and adopted in several European regions and cities with notable results. This student-based activity is especially relevant for regions suffering from brain drain (Walbrzych subregion, Podlaskie).

### Improve linkages and flow of information

- **Gather evidence of the PRO’s portfolio (intellectual property, equipment, and expertise) and make it easily accessible for companies.** The intellectual assets should be standardized in all PRO’s to enable easy search and access, since companies often complained that it is difficult to

### Improve the effectiveness and targeting of the existing policy mix

- **Improve local government capabilities to design and implement I&E programmes.**
- **Increase the utilization of national and EU programmes.**
- **Design new I&O programme schemes with low administrative demands.**

### Align supply-side capabilities to the demand-side (research relevance)

- **Prioritize the actions in sectors with the highest potential for successful tech transfer (nanotech in Lodzkie, medical technology in Podlaskie, and automotive and industry in Walbrzych).**

### Address complementarities for the entrepreneurial ecosystem

- **Share international experience.**
- **Introduce initiatives and activities that would help to attract risk capital, angel capital in particular.**
quickly find what they need. Establishing a shared database of IP assets, research/testing/measurement skills, and research equipment could help address this informational asymmetry problem and allow a single point of contact for industry. Marketing the most promising intellectual property through both formal and informal channels could also enabled the commercialization of existing IP. This activity could also help to leverage the utilization of the PRO’s research equipment for the benefit of local enterprises.

- **Share and pool resources across PRO’s to make technology transfer and industry cooperation more effective.** This is especially important in regions with limited research resources (such as Podlaskie or Walbrzych). Support the setup of collaborative academia-industry platforms for coordinating technology transfer activities in the region and address specific regional needs through networking and promotional activities. Organize joint activities (networking, speed dating etc.) to support collaboration and mutual trust building between universities and companies.

- **Support TTCs in disseminating information about technology transfer and research commercialization potentials within PROs to raise awareness among researcher and motivate them to cooperation with entrepreneurs and innovative enterprises.** Support promotional and networking workshops targeting researchers and students with focus on the role of CTTs, market opportunities, and existing research commercialization support mechanisms. Such events would help change the common perception that CTT generates extra duties and would highlight its added value for researchers. It is difficult to manage cooperation with external private partners when internal stakeholders are not cooperative.

**Improve the effectiveness and targeting of the existing policy mix**

- **Improve local government capabilities to design, implement, and monitor innovation and entrepreneurship programs to increase impact and effectiveness.** Some of the existing regional support programs suffer from low uptake and fall short from achieving their stated objectives. Evaluate the existing policy mix to ensure alignment with the stated objectives and needs of the region. Deliver targeted capacity building to local authorities’ institutions and agencies to enhance their managerial and programmatic capabilities. Introduce a robust monitoring and evaluation framework to continuously assess the effectiveness and targeting of such programs and introduce adjustments when necessary.

- **Promote and upgrade existing I&E regional programs and experiment with new ones.** Some of the existing programs could be better promoted and communicated to potential beneficiaries. A limited number of companies knew about public support possibilities or perceived the application process as cumbersome. Experiment with support programs that are simple administratively and could achieve behavioral change among enterprises; such as innovation vouchers. Voucher schemes are relatively cheap and easy to design and implement. Moreover, recipient of innovation vouchers are often candidates for more strategic cooperation.

- **Leverage existing national and EU programs through co-financing of applied research projects which rank above the threshold but were not selected for funding.** Low utilization of these programs is typical for less developed regions, which have to compete with national or European contenders. However, some projects, even if not selected in such competition, could have
potential spill over benefits on the regional level. Co-financing of these projects could motivate more local companies and PROs to participate in such schemes and ultimately increase the uptake of national and EU programs.

Align supply-side capabilities to the demand-side: research relevance

- **In Lodzkie, scale up support within the region’s specialization in the nanotechnologies, which are leveraging the textile industry tradition.** Set up formal or informal mechanisms for partnership to connect stakeholders active in this field regionally and with European and global initiatives. Strengthen the role of BioNanoPark, which is a natural leader for such an activity. The support might be financial or strategic, such as recommending projects with significant regional importance for financing through national or EU programs.

- **In Podlaskie, encourage cooperation in the medical technology, which shows strong capabilities at the PROs and within companies.** Build on the experience from the Metal Processing Cluster to support the development of a Medical Technology cluster. Through the cluster, support cooperation within specific targeted actions (such as PoC program in fields with significant regional importance) and consider adding horizontal perspective in other regional programs.

- **In Walbrzych, utilize the strong presence of the automotive and chemistry industry in the region.** Introduce mechanisms to encourage PROs and companies and industry representatives to network and cooperation. Host networking events focused on specific subsectors of relevance to both PROs and the local industries with European and global players. Introduce regional and European experiences in establishing cooperation mechanisms and centres of excellence around thematic areas.

Address complementarities for the entrepreneurial ecosystem

- **Support local innovation intermediaries and cultivate the local ecosystem by improving their capabilities through sharing international experience.** This activity is especially useful in “fragmented regions”, which enjoy satisfactory capacity at both PROs and companies but are not very well connected (such as Lodzkie). Encourage entrepreneurship and business support intermediaries to introduce investment readiness programs focused on building teams’ business and entrepreneurial skills. Connect local entrepreneurs and start-ups to national or European initiatives (for example EIT Health hub and similar initiatives) using the network of local intermediaries (hubs, incubators, accelerators, coworking spaces, etc.).

- **Introduce initiatives and activities that would help attract risk capital, angel capital in particular, and the needed knowhow and mentorship for start-up growth.** Experienced early stage angel investors (ecosystem builders) are especially needed. Organize pitching events with investors or other external companies specialized in early stage investments. Risk investors could help in identifying teams and projects with commercialization potentials and provide the needed mentorship on market fit and monetization models. Attracting regional/European investors might especially help in regions such as Lodzkie, where there is a potential for scaling up existing startups and internationalization of technology transfer.
References


Regional Innovation Strategy for the Lodzkie Region LORIS 2030.


Annex 1: Łódzkie Additional Figures

Table 20. Average monthly gross wages and salaries in regional peers in relation to the Polish mean (Poland = 100) between 2008 and 2017

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Source: Polish statistical office, 2018

Figure 15. Intramural R&D expenditures (GERD) by NUTS 2 regions, in % of GDP

Source: Polish statistical office, 2018; data for French regions not available for year 2015, data for Niederbayern available only for year 2015
Figure 16. Employment in R&D by economic sectors, 2015, regional comparison

Source: Eurostat, Polish statistical office, 2018; note: regions Lubuskie and Świętokrzyskie not included due to data availability; French regions relate to year 2013

Figure 17. Granted patents by NUTS 2 regions in 2017 (in %, normalized by population)

Source: Polish Patent Office, 2018

Table 21. Unemployment rate by selected NUTS 2 regions between 2008 and 2017 (Lódzkie)

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</table>

Source: Eurostat, 2018; note: regions selected as regional peers (Polish regions, fields with blue background), structural peers (lagging regions or with structural similarities with studied regions; fields with light red background), and aspirational peers (fields with green background), see theoretical chapter above; more info also: http://tools.orkestra.deusto.es/s3platform/benchmark/

Table 22. Companies with highest growths in Lodzkie in 2018
### Table 23. Demand-side participations in Horizon 2020 and FP7 by application projects and topic (years 2008-2018)

<table>
<thead>
<tr>
<th>Name</th>
<th>R</th>
<th>EC contrib.</th>
<th>N</th>
<th>Topic/program</th>
</tr>
</thead>
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<td>BERGAMO TECNOLOGIE SPZOO</td>
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<td>3 244 316</td>
<td>11</td>
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<tr>
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<td>P</td>
<td>674 016</td>
<td>5</td>
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<tr>
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<td>Research for the benefit of SMEs</td>
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<td>P</td>
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<td>2</td>
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<tr>
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<td>P</td>
<td>291 475</td>
<td>2</td>
<td>Technologies for Factories of the Future</td>
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<tr>
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<td>P</td>
<td>680 625</td>
<td>1</td>
<td>Bio-based Industries Joint Technology Initiative</td>
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<tr>
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<td>P</td>
<td>321 550</td>
<td>1</td>
<td>Market uptake of energy innovation</td>
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<td>MALEX ZAKŁAD UTYLIZACJI ODPADÓW MONIKA MŁACKA</td>
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<td></td>
<td><strong>7 370 271</strong></td>
<td><strong>35</strong></td>
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</table>

Source: Cordis, European Commission; note: R means role in project, C = coordinator, P = participant; N means number of participations
Annex 2: Podlaskie Additional Figures

Table 24. Unemployment rate by selected NUTS 2 regions between 2008 and 2017 (Podlaskie)

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<td>Wielkopolskie (PL)</td>
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<td>7.5</td>
<td>5.7</td>
<td>4.7</td>
<td>3.1</td>
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<tr>
<td>Nord-Vest (RO)</td>
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<td>5.5</td>
<td>6.6</td>
<td>5.0</td>
<td>4.5</td>
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<td>3.4</td>
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<tr>
<td>Dél-Alföld (HU)</td>
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<td>10.3</td>
<td>10.4</td>
<td>10.2</td>
<td>10.8</td>
<td>8.8</td>
<td>7.7</td>
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<td>8.9</td>
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</tr>
<tr>
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<td>5.8</td>
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<td>7.7</td>
<td>7.9</td>
<td>7.9</td>
<td>7.1</td>
<td>6.4</td>
<td>5.5</td>
<td>4.8</td>
</tr>
<tr>
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<td>16.0</td>
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<td>15.9</td>
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<td>10.2</td>
<td>8.4</td>
<td>6.1</td>
<td>5.7</td>
</tr>
<tr>
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<td>8.6</td>
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<td>10.0</td>
<td>9.5</td>
<td>9.5</td>
<td>8.8</td>
<td>10.1</td>
<td>8.5</td>
<td>6.6</td>
</tr>
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<td>Warmińsko-Mazurskie (PL)</td>
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<td>8.4</td>
<td>9.5</td>
<td>9.3</td>
<td>10.8</td>
<td>11.1</td>
<td>9.6</td>
<td>9.4</td>
<td>8.7</td>
<td>7.1</td>
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<tr>
<td>Észak-Alföld (HU)</td>
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<td>13.9</td>
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<td>10.6</td>
<td>9.0</td>
<td>7.1</td>
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<tr>
<td>EU 28</td>
<td>6.7</td>
<td>8.6</td>
<td>9.3</td>
<td>9.4</td>
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<td>10.0</td>
<td>9.2</td>
<td>8.4</td>
<td>7.5</td>
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</table>

Source: Eurostat, 2018; note: regions selected as regional peers (Polish regions, fields with blue background), structural peers (lagging regions or with structural similarities with studied regions; fields with light red background), and aspirational peers (fields with green background), see theoretical chapter above; more info also: http://tools.orkestra.deusto.es/s3platform/benchmark/

Table 25. The companies with biggest revenues in Podlaskie in 2017/2016

<table>
<thead>
<tr>
<th>Company name</th>
<th>NACE dig.2</th>
<th>NACE dig.4</th>
<th>Turnover in thousands EUR</th>
<th>Turnover average growth in % (last 3 years)</th>
<th>Share on the overall output</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPÓŁDZIELNIA MLECZARSKA MLEKOVITA</td>
<td>Manufacture of food products</td>
<td>Operation of dairies and cheese making</td>
<td>815 518</td>
<td>101</td>
<td>7,3</td>
</tr>
<tr>
<td>SPÓŁDZIELNIA MLECZARSKA MLEKPOL W GRAJEWIE</td>
<td>Manufacture of food products</td>
<td>Operation of dairies and cheese making</td>
<td>735 717</td>
<td>98</td>
<td>6,6</td>
</tr>
<tr>
<td>OIL TRANSFER INVESTMENT SP. Z O.O.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of solid, liquid and gaseous fuels and related products</td>
<td>490 051</td>
<td>52 758</td>
<td>4,4</td>
</tr>
<tr>
<td>UNIBEP S.A.</td>
<td>Construction of buildings</td>
<td>Construction of residential and non-residential buildings</td>
<td>392 448</td>
<td>117</td>
<td>3,5</td>
</tr>
<tr>
<td>OKRĘGOWA SPÓŁDZIELNIA MLECZARSKA W PIĄTNICY</td>
<td>Manufacture of food products</td>
<td>Operation of dairies and cheese making</td>
<td>233 876</td>
<td>104</td>
<td>2,1</td>
</tr>
<tr>
<td>SPÓŁDZIELNIA OBROTU TOWAROWEGO PRZEMYSŁU MLECZARSKIEGO</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of dairy products, eggs and edible oils and fats</td>
<td>221 731</td>
<td>107</td>
<td>2,0</td>
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<tr>
<td>SUEMPOL SP. Z O.O.</td>
<td>Manufacture of food products</td>
<td>Processing and preserving of fish, crustaceans and molluscs</td>
<td>194 540</td>
<td>101</td>
<td>1,7</td>
</tr>
<tr>
<td>DANWOOD S.A.</td>
<td>Construction of buildings</td>
<td>Construction of residential and non-residential buildings</td>
<td>151 385</td>
<td>360</td>
<td>1,4</td>
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</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk, 2018
### Table 26. Ten fastest growing manufacturing fields according to revenues in Podlaskie by NACE

<table>
<thead>
<tr>
<th>Economic activity</th>
<th>Number of companies</th>
<th>Operating revenue 2016-2017 (thousands EUR)</th>
<th>Operating revenue 2011-2012 (thousands EUR)</th>
<th>share on manufacturing (%)</th>
<th>Relative growth compared to Polish average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of motor vehicles</td>
<td>1</td>
<td>97 799</td>
<td>1 063</td>
<td>2,1</td>
<td>7 477</td>
</tr>
<tr>
<td>Manufacture of structural metal products</td>
<td>14</td>
<td>69 460</td>
<td>16 032</td>
<td>1,5</td>
<td>240</td>
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<tr>
<td>Manufacture of other fabricated metal products</td>
<td>6</td>
<td>55 378</td>
<td>14 180</td>
<td>1,2</td>
<td>267</td>
</tr>
<tr>
<td>Manufacture of articles of paper and paperboard</td>
<td>8</td>
<td>105 220</td>
<td>33 941</td>
<td>2,2</td>
<td>181</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>21</td>
<td>391 595</td>
<td>126 335</td>
<td>8,3</td>
<td>187</td>
</tr>
<tr>
<td>Manufacture of prepared animal feeds</td>
<td>8</td>
<td>186 538</td>
<td>87 912</td>
<td>4,0</td>
<td>122</td>
</tr>
<tr>
<td>Manufacture of furniture</td>
<td>12</td>
<td>107 786</td>
<td>51 812</td>
<td>2,3</td>
<td>124</td>
</tr>
<tr>
<td>Processing and preserving of fish, crustaceans and molluscs</td>
<td>2</td>
<td>196 548</td>
<td>101 661</td>
<td>4,2</td>
<td>108</td>
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<tr>
<td>Treatment and coating of metals; machining</td>
<td>6</td>
<td>32 392</td>
<td>17 417</td>
<td>0,7</td>
<td>117</td>
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<tr>
<td>Manufacture of articles of concrete, cement and plaster</td>
<td>13</td>
<td>78 765</td>
<td>44 457</td>
<td>1,7</td>
<td>146</td>
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</table>

Source: Amadeus by Moody's Analytics / Bureau van Dijk, 2018; note: only economic activities with 0,5% and higher share on manufacturing are included; NACE Revision 2 dig.3 used; Relative growth compared to Polish average is calculated as a ratio between the growth (2017/2012) in operating revenues in the region and the growth in operating revenues in Poland.
Annex 3: Walbrzych (Lower Silesia) Additional Figures

Table 27. Lower Silesia unemployment rates by NUTS 2 regions (%)

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<tbody>
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<td>Jihovýchod (CZ)</td>
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<td>6.4</td>
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<td>7.0</td>
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<td>4.8</td>
<td>3.6</td>
<td>3.1</td>
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<td>8.6</td>
<td>8.5</td>
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<td>7.5</td>
<td>5.7</td>
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<tr>
<td>Nord-Vest (RO)</td>
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<td>6.6</td>
<td>5.0</td>
<td>4.5</td>
<td>4.0</td>
<td>3.8</td>
<td>4.5</td>
<td>4.1</td>
<td>3.4</td>
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<tr>
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<td>6.3</td>
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<td>9.5</td>
<td>8.2</td>
<td>6.4</td>
<td>4.5</td>
<td>3.6</td>
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<td>10.3</td>
<td>10.4</td>
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<td>8.9</td>
<td>7.4</td>
<td>6.1</td>
<td>4.8</td>
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<td>16.3</td>
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<td>8.5</td>
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<td>8.2</td>
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<td>13.9</td>
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<td>14.5</td>
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<td>11.5</td>
<td>10.6</td>
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<td>EU 28</td>
<td>6.7</td>
<td>8.6</td>
<td>9.3</td>
<td>9.4</td>
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<td>10.6</td>
<td>10.0</td>
<td>9.2</td>
<td>8.4</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Table 28. Supply side participations in Horizon 2020 and FP7 by application projects and topic (years 2008-2018)

<table>
<thead>
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<th>Name</th>
<th>EC contrib.</th>
<th>N</th>
<th>Topic/program</th>
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<tr>
<td>POLITECHNIKA WROCŁAWSKA</td>
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<td></td>
<td></td>
<td>materials and new production technologies; Sustainable, resource-efficient and</td>
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<td></td>
<td></td>
<td></td>
<td>low-carbon technologies in energy-intensive process industries</td>
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<tr>
<td>KGHM CUPRUM SP ZOO CENTRUM BADAWCZO-ROZWOJOWE</td>
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<td>7</td>
<td>Nanosciences, nanotechnologies, materials and new production technologies;</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Supply of non-energy and non-agricultural raw materials</td>
</tr>
<tr>
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<td>P</td>
<td>7</td>
<td>Green Cities for Climate and Water Resilience, Sustainable Economic Growth,</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Healthy Citizens and Environments; Transport (including Aeronautics)</td>
</tr>
<tr>
<td>WROCLAW MIASTO</td>
<td>P</td>
<td>3</td>
<td>Information and communication technologies</td>
</tr>
<tr>
<td>WROCŁAWSKIE CENTRUM BADAN EIT+ SPZOO</td>
<td>P</td>
<td>9</td>
<td>Space; Security</td>
</tr>
<tr>
<td>UNIWERSYTET WROCŁAWSKI</td>
<td>P</td>
<td>6</td>
<td>Green Cities for Climate and Water Resilience, Sustainable Economic Growth,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Healthy Citizens and Environments; Food, agriculture and fisheries, and</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>biotechnology</td>
</tr>
<tr>
<td>INSTYTUT NISKICH TEMPERATUR I BADAN STRUKTURALNYCH IM. WŁÓDZIMIERZA TRZEBIATOWSKIEGO POLSKIEJ AKADEMII NAUK</td>
<td>P</td>
<td>3</td>
<td>FET Open; Transport (including Aeronautics)</td>
</tr>
<tr>
<td>WOJSKOWY INSTYTUT TECHNIKI INZYNIERJENNEJ IM PROFESORA JOZEFOS KOSACKIEGO</td>
<td>P</td>
<td>1</td>
<td>Security</td>
</tr>
<tr>
<td>Urzad Marszalkowski Wojewodztwa Dolnoslaskiego</td>
<td>P</td>
<td>2</td>
<td>Nanosciences, nanotechnologies, materials and new production technologies;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Universal Preventive Resilience Intervention Globally implemented in schools to</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>improve and promote mental Health for Teenagers</td>
</tr>
<tr>
<td>DOLNOSLASKI PARK INNOWACJI I NAUKI S.A.</td>
<td>P</td>
<td>4</td>
<td>Nanosciences, nanotechnologies, materials and new production technologies</td>
</tr>
<tr>
<td>STOWARZYSZENIE CENTRUM ROZWIAZAN SYSTEMOWYCH</td>
<td>P</td>
<td>2</td>
<td>Cultural heritage</td>
</tr>
<tr>
<td>UNIWERSYTET EKONOMICZNY WE WROCŁAWSIU</td>
<td>P</td>
<td>1</td>
<td>Scaling up Co-creation: Avenues and Limits for Integrating Society in Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>and Innovation</td>
</tr>
</tbody>
</table>
Table 29. Ten fastest growing manufacturing fields according to revenues in Walbrzych sub-region by NACE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacture of glass and glass products</td>
<td>2</td>
<td>37 798</td>
<td>9 858</td>
<td>383</td>
<td>0,9</td>
<td>170</td>
</tr>
<tr>
<td>Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms</td>
<td>3</td>
<td>79 859</td>
<td>26 842</td>
<td>298</td>
<td>2,0</td>
<td>124</td>
</tr>
<tr>
<td>Manufacture of other food products</td>
<td>4</td>
<td>21 635</td>
<td>10 312</td>
<td>210</td>
<td>0,5</td>
<td>117</td>
</tr>
<tr>
<td>Manufacture of plastic products</td>
<td>14</td>
<td>115 500</td>
<td>68 480</td>
<td>169</td>
<td>2,9</td>
<td>166</td>
</tr>
<tr>
<td>Manufacture of instruments and appliances for measuring, testing and navigation; watches and clocks</td>
<td>4</td>
<td>39 505</td>
<td>23 432</td>
<td>169</td>
<td>1,0</td>
<td>151</td>
</tr>
<tr>
<td>Manufacture of structural metal products</td>
<td>11</td>
<td>56 021</td>
<td>33 592</td>
<td>167</td>
<td>1,4</td>
<td>180</td>
</tr>
<tr>
<td>Manufacture of domestic appliances</td>
<td>2</td>
<td>28 028</td>
<td>17 071</td>
<td>164</td>
<td>0,7</td>
<td>150</td>
</tr>
<tr>
<td>Manufacture of other special-purpose machinery</td>
<td>3</td>
<td>22 451</td>
<td>13 753</td>
<td>163</td>
<td>0,6</td>
<td>140</td>
</tr>
<tr>
<td>Treatment and coating of metals; machining</td>
<td>18</td>
<td>95 966</td>
<td>59 633</td>
<td>161</td>
<td>2,4</td>
<td>159</td>
</tr>
<tr>
<td>Manufacture of railway locomotives and rolling stock</td>
<td>2</td>
<td>172 304</td>
<td>114 126</td>
<td>151</td>
<td>4,3</td>
<td>133</td>
</tr>
</tbody>
</table>

Table 30. Companies with highest growths in Walbrzych region in 2017/2016

<table>
<thead>
<tr>
<th>Company name</th>
<th>NACE dig.2</th>
<th>NACE dig.4</th>
<th>Turnover in thous. EUR</th>
<th>T1 in %</th>
<th>T2 in %</th>
<th>T3 in %</th>
</tr>
</thead>
<tbody>
<tr>
<td>MANDO CORPORATION POLAND SP. Z O.O.</td>
<td>Manufacture of motor vehicles, trailers and semi-trailers</td>
<td>Manufacture of other parts and accessories for motor vehicles</td>
<td>104 227</td>
<td>150</td>
<td>187</td>
<td>225</td>
</tr>
<tr>
<td>SPOŁDZIELNIA MIESZKANIOWA</td>
<td>Real estate activities</td>
<td>Management of real estate on a fee or contract basis</td>
<td>10 464</td>
<td>205</td>
<td>210</td>
<td>192</td>
</tr>
<tr>
<td>WODOCIĄGI I KANALIZACJA SP. Z O.O.</td>
<td>Water collection, treatment and supply</td>
<td>Water collection, treatment and supply</td>
<td>10 217</td>
<td>210</td>
<td>210</td>
<td>204</td>
</tr>
<tr>
<td>MIGAPOL SP. Z O.O.</td>
<td>Manufacture of fabricated metal products, except machinery and equipment</td>
<td>Manufacture of wire products, chain and springs</td>
<td>9 580</td>
<td>138</td>
<td>666</td>
<td>151</td>
</tr>
<tr>
<td>Company</td>
<td>Technology specialization</td>
<td>NACE dig.4</td>
<td>Turnover in thous. EUR</td>
<td>Number of patents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>------------------------</td>
<td>-------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRZEDSIĘBIORSTWO HANDLOWO-USŁUGOWE REMETEX ANDRZEJ LUDWIKOWSKI BOGUMIŁA LUDWIKOWSKA SP. J.</td>
<td>Wholesale trade, except of motor vehicles and motorcycles</td>
<td>Wholesale of perfume and cosmetics</td>
<td>9 268</td>
<td>123</td>
<td>122</td>
<td>124</td>
</tr>
<tr>
<td>ZAKŁAD WODOCIĄGÓW I KANALIZACJI SP. Z O.O.</td>
<td>Water collection, treatment and supply</td>
<td>Water collection, treatment and supply</td>
<td>7 416</td>
<td>404</td>
<td>415</td>
<td>406</td>
</tr>
<tr>
<td>NOVA SP. Z O.O.</td>
<td>Retail trade, except of motor vehicles and motorcycles</td>
<td>Retail sale of automotive fuel in specialised stores</td>
<td>7 144</td>
<td>194</td>
<td>174</td>
<td>250</td>
</tr>
<tr>
<td>AUTOFORTE.PL SP. Z O.O.</td>
<td>Wholesale and retail trade and repair of motor vehicles and motorcycles</td>
<td>Sale of cars and light motor vehicles</td>
<td>6 766</td>
<td>169</td>
<td>121</td>
<td>132</td>
</tr>
</tbody>
</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk, 2018; notes: only companies with annual turnover higher than 5 mil. EUR (with two exceptions in italics with extremely high growth) and growth higher than 20% over the past 3 years included; data for turnover refer to 2017 or 2016; T1, T2 and T3 stand for turnover in % compared with the previous year, T1 corresponds with last available year.

Table 31. Top patent applicants by companies in Walbrzych sub-region in 2018

<table>
<thead>
<tr>
<th>Company</th>
<th>Technology specialization</th>
<th>NACE dig.4</th>
<th>Turnover in thous. EUR</th>
<th>Number of patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAPRICORN S.A.</td>
<td>Civil engineering; Mechanical elements</td>
<td>Manufacture of plastic plates, sheets, tubes and profiles</td>
<td>14 415</td>
<td>22</td>
</tr>
<tr>
<td>WAGONY ŚWIDNICA SP. Z O.O.</td>
<td>Transport</td>
<td>Manufacture of railway locomotives and rolling stock</td>
<td>171 183</td>
<td>9</td>
</tr>
<tr>
<td>LIW-LEWANT FABRYKA WYROBÓW Z TWORZYW SZTUCZNYCH SP. Z O.O.</td>
<td>Optics</td>
<td>Manufacture of optical instruments and photographic equipment</td>
<td>4 104</td>
<td>5</td>
</tr>
<tr>
<td>SOLGAZ SP. Z O.O. Z SIEDZIBĄ W DZIERŻONOWIE</td>
<td>Thermal processes and apparatus</td>
<td>Manufacture of non-electric domestic appliances</td>
<td>4 814</td>
<td>4</td>
</tr>
<tr>
<td>BEYSTER SP. Z O.O. S.K.</td>
<td>Basic materials chemistry</td>
<td>Other manufacturing n.e.c.</td>
<td>2 874</td>
<td>3</td>
</tr>
<tr>
<td>PRZEDSIĘBIORSTWO FARMACEUTYCZNE OKONIEWSCY VETOS FARMA SP. Z O.O.</td>
<td>Pharmaceuticals</td>
<td>Manufacture of basic pharmaceutical products</td>
<td>7 007</td>
<td>3</td>
</tr>
<tr>
<td>SONEL S.A.</td>
<td>Measurement</td>
<td>Manufacture of instruments and appliances for measuring, testing and navigation</td>
<td>21 253</td>
<td>2</td>
</tr>
<tr>
<td>CZARNA GÓRA S.A.</td>
<td>Transport</td>
<td>Other passenger land transport n.e.c.</td>
<td>5 039</td>
<td>2</td>
</tr>
<tr>
<td>FABRYKA APARATURE POMIAROWEJ PAFAL S.A.</td>
<td>Measurement</td>
<td>Manufacture of instruments and appliances for measuring, testing and navigation</td>
<td>13 805</td>
<td>2</td>
</tr>
</tbody>
</table>

Source: Amadeus by Moody’s Analytics / Bureau van Dijk; Orbit by Questel, 2018; data for turnover refer to 2017 or 2016
Annex 4: Stakeholders Mapping

This annex maps key existing institutions in each of three studied regions: Lower Silesia, Lodzkie, and Podlaskie (in Lower Silesia the mapping was limited to Walbrzych Subregion). The mapping is based on the direct counterpart recommendations, public documents, desk research, and a number of interviews.

The following criteria for including the stakeholders in the mapping were applied:

- Stakeholder must be located in the region (national counterparts offering services to the units in the regions are not taken into consideration);
- The ownership is of secondary importance – stakeholder can be public or private;
- The stakeholder supports companies, universities, individuals (e.g. students) or consortia directly, or providing programs that could be used for direct benefit;
- The stakeholder has a key role of supporting innovation by offering any innovation-related services, being on the supply-side of innovation, or matchmaking the supply and demand, or loosely linked to supporting I&E ecosystem;
- Whether an institution actually provides services enlisted in its mission is not relevant for this mapping.

Table 32. I&E ecosystem stakeholders in three Polish regions

<table>
<thead>
<tr>
<th>No.</th>
<th>Institution</th>
<th>Details</th>
<th>Role in the ecosystem</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Silesia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Lower Silesia Marshal Office</td>
<td>Wrocław-located Marshal Office for Lower Silesia region</td>
<td>To facilitate the regional innovation policy and ensure well-targeted disbursement of EU funds (ROP)</td>
</tr>
<tr>
<td>2.</td>
<td>Wałbrzych City Council</td>
<td>Wałbrzych City Council is the municipal authority responsible for wide range of municipal policies, including innovation and entrepreneurship</td>
<td>Support the regional innovation policies on a city-level with city council programs</td>
</tr>
<tr>
<td>3.</td>
<td>CityLAB</td>
<td>120-square meter experimentation space based in a renovated old mine close to Wałbrzych city centre</td>
<td>Offers experimentation, presentation and work space, along with basic equipment for 3D printing, 3D scanning, woodworking.</td>
</tr>
<tr>
<td>4.</td>
<td>T-Park</td>
<td>Technology Park offering incubation space and a workshop, hosting 16 companies and local agencies</td>
<td>T-Park offers incubation space for new companies for reduced price, small workshop, wide variety of pro-innovation services and matching with Public Research Organizations</td>
</tr>
<tr>
<td>5.</td>
<td>Dolnośląskie Agency for Regional Development</td>
<td>Development Agency located in Wałbrzych</td>
<td>Agency offers a number of pro-innovation services, innovation vouchers, and matching companies with universities/research institutes</td>
</tr>
<tr>
<td></td>
<td><strong>Dolnośląscy Pracodawcy</strong></td>
<td><strong>The biggest Employers’ Association in Wałbrzych Subregion</strong></td>
<td>Networking, matching companies with universities/research institutes, offering innovation vouchers</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>7.</td>
<td><strong>Wrocław University of Technology (Walbrzych branch)</strong></td>
<td><strong>Largest University of Technology in Lower Silesia region (almost 30k students and 2100 academic workers)</strong></td>
<td>Offering lab services, services for the innovation vouchers and other innovation projects, number of patented inventions</td>
</tr>
<tr>
<td>8.</td>
<td><strong>Space Research Centre of Polish Academy of Sciences (Walbrzych branch)</strong></td>
<td><strong>An interdisciplinary research institute of the Polish Academy of Sciences, established to conduct scientific research and activities in order to develop the space industry in Poland</strong></td>
<td>Participate in international space missions and research programs, research based on the results of satellite experiments on space physics and physical and geodynamic processes on planets and on Earth</td>
</tr>
<tr>
<td>9.</td>
<td><strong>University of Casimir the Great in Bydgoszcz – Didactic Center in Wałbrzych</strong></td>
<td><strong>Kazimierz Wielki University in Bydgoszcz, also known as the Casimir the Great University, is a state-funded university in Bydgoszcz, Poland.</strong></td>
<td>Didactic Center in Wałbrzych.</td>
</tr>
</tbody>
</table>

---

<p>| <strong>Lodzkie</strong> |
|---|---|---|
| 1. | <strong>Lodzkie Marshal Office</strong> | Marshal Office for Lodzkie region | To facilitate the regional innovation policy and ensure well-targeted disbursement of EU funds (ROP) |
| 2. | <strong>Lodzkie City Council</strong> | Lodz City Council is the municipal authority responsible for wide range of municipal policies, including innovation and entrepreneurship | Support the regional innovation policies on a city-level with a large number of city council programs, enhancing entrepreneurship and innovation by offering top-notch mentoring services, incubation spaces, matching with universities and large companies |
| 3. | <strong>University of Lodz</strong> | Largest PRO in Lodzkie, with 32.6k students and almost 4k academic employees | Largest local university offering cooperation under joint research projects financed by Innovation vouchers and EU Funds, as well as contract research services |
| 4. | <strong>Lodz Medical University</strong> | Public Medical University in Lodz, hosting ca. 8k students | Key local actor in the medical sector on the supply side of innovations, large number of patented inventions, offering contract research services and cooperation in grant/research projects |
| 5. | <strong>Lodz University of Technology</strong> | Public University of Technology, largest in Lodzkie, with 17.5k students and 2.8k academic employees | Key player on supply side of innovations in Lodzkie region, offering lab services (contract research), cooperation in grant/research projects, with patents and licenses for ready-to-implement technologies, incubation space and mentoring are also available |
| 6. | <strong>Academy of Fine Arts</strong> | Largest Fine Arts Academy in Lodzkie region and one of the largest in Poland, with ca. 1.3k students | Key player supporting a number of companies and organizations (e.g., City Council) in the industrial design via number of events organized by the city |</p>
<table>
<thead>
<tr>
<th></th>
<th>Research Institution</th>
<th>Description</th>
<th>Collaborations</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
<td>Centre of Molecular and Macromolecular Studies of Polish Academy of Sciences</td>
<td>Research institution of the Polish Academy of Sciences.</td>
<td>Key player on supply side offers laboratories and is open for applied research collaboration with companies from Poland and abroad.</td>
</tr>
<tr>
<td>8.</td>
<td>Textile Research Institute</td>
<td>Research institution specializing in the textile industry.</td>
<td>Participating in many scientific and research projects in Poland and on the international level (EU).</td>
</tr>
<tr>
<td>9.</td>
<td>Institute of Biopolymers and Chemical Fibres</td>
<td>Research institution in fields such as biopolymers, biomaterials, synthetic polymers and fibres, biotechnology, nanotechnology, pulp and paper and environment protection.</td>
<td>Key supply-side player offering accredited testing and experimental production. The Organization is also active in patent application.</td>
</tr>
<tr>
<td>10.</td>
<td>Research Institute of Horticulture</td>
<td>R&amp;D organization supervised by the Ministry of Agriculture and Rural Development.</td>
<td>Taking part in several governmental research programs on food safety, integrated and organic fruit and vegetable production, protection of genetic resources, etc. Offering commercial activities in food analysis and participating in European research programs.</td>
</tr>
<tr>
<td>11.</td>
<td>Institute of Leather Industry in Lodz</td>
<td>Research institution specializing in leather industry and associated disciplines.</td>
<td>Active in contractual research and consulting. Involved in European and Polish R&amp;D projects.</td>
</tr>
<tr>
<td>12.</td>
<td>Institute of Medical Biology of Polish Academy of Sciences</td>
<td>Public R&amp;D institution conducting scientific research in biomedical sciences and biotechnology.</td>
<td>One of the key players in the region participating in H2020 projects and in Polish research programs. Active in patent application.</td>
</tr>
<tr>
<td>14.</td>
<td>European Regional Centre for Ecohydrology</td>
<td>Transdisciplinary ecohydrological research on sustainable management, protection, and restoration of aquatic resources at the catchment scale.</td>
<td>Networking for innovative ecohydrological solutions and improvement of environmental consciousness of society. International cooperation in the framework of UNESCO International Hydrological Program and European Commission projects.</td>
</tr>
<tr>
<td>15.</td>
<td>BioNanoPark</td>
<td>Joint Venture (university, city, region) in a form of science-techno park with a focus on Biotech and IT</td>
<td>Key focus of BNP is biotech-focused research, but it’s also an incubator and development area for bigger companies/investors</td>
</tr>
<tr>
<td><strong>16.</strong> Institute of Security Technologies MORATEX</td>
<td>State security research facility directed by Ministry of Interior Affairs and Administration</td>
<td>The main goal of MORATEX activity is to develop modern designs and technologies of textile technical goods and implementing them to the industry. MORATEX is the departmental R&amp;D body supervised by the Minister of Interior and Administration.</td>
<td></td>
</tr>
<tr>
<td><strong>17.</strong> EIT Health</td>
<td>EIT Health is a network of health innovators backed by the EU</td>
<td>EITH delivers solutions to companies and universities to improve the healthy lives, matchmaking of supply and demand services on European level, networking, educational function is also key to its activities.</td>
<td></td>
</tr>
<tr>
<td><strong>18.</strong> SkyHUB</td>
<td>A free coworking space in the centre of Lodz</td>
<td>SkyHUB offers free coworking space, networking events and lectures by successful entrepreneurs, along with mentoring services.</td>
<td></td>
</tr>
<tr>
<td><strong>19.</strong> Business Innovation Centres</td>
<td>A network of business experts in Lodzkie region to increase the awareness of Lodzkie ROP and its uptake</td>
<td>Raising awareness, identification and responding to companies’ needs, enhancing the uptake of the ROP.</td>
<td></td>
</tr>
</tbody>
</table>

### Podlaskie

<p>| <strong>1.</strong> Podlaskie Marshal Office | Marshal Office for Podlaskie region | To facilitate the regional innovation policy and ensure well-targeted disbursement of EU funds (ROP). |
| <strong>2.</strong> BPN-T | Science-techno park located in Bialystok | BPNT offers a wide variety of pro-innovation services, among them: incubation space, coworking space, conference rooms, mentoring services, legal and accounting services, networking events and thematic lectures. |
| <strong>3.</strong> Metal Processing Cluster | Cluster of metal processing, manufacturing companies, recently focusing also on Industry 4.0, automation, and other manufacturers (e.g., plastic, composites, etc.). | The cluster promotes close cooperation of companies, offers top-notch networking and matchmaking services, and is awarded with the ‘National Key Cluster’ status (highest accolade among clusters in Poland). |
| <strong>4.</strong> Bialystok University | Public University, largest PRO in the region with 17k students and 850 academic employees | Largest local university offering cooperation under joint research projects financed by Innovation vouchers and EU Funds. |
| <strong>5.</strong> Bialystok University of Technology | Largest technical university in the region with 8.5k students and 660 teachers | Key supply-side player in Podlaskie region offering cooperation under joint research projects financed by Innovation vouchers and EU Funds. |
| <strong>6.</strong> Medical University Bialystok | Medical university with 5k students and 800 academic employees | Cooperation with entrepreneurs from various industries and commercializing inventions. Participation in joint research projects financed by EU funds. |</p>
<table>
<thead>
<tr>
<th>7.</th>
<th>Mammal Research Institute of the Polish Academy of Sciences</th>
<th>Research institution located in Białowieża Forest and the EU Centre Excellence</th>
<th>The Institute actively co-operates with a number of scientific institutions abroad on joint research projects, and organizes conferences, seminars, staff exchange and training.</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>University of Medical Science in Białystok</td>
<td>Local university in Białystok focusing on physiotherapy, cosmetology and nursing</td>
<td>Especially educational role, participating in Polish research programs.</td>
</tr>
<tr>
<td>9.</td>
<td>Lomza State University of Applied Sciences</td>
<td>Local public university</td>
<td>Cooperation with socio-economic institutions, participating in research projects.</td>
</tr>
<tr>
<td>10.</td>
<td>The University of Finance and Management, and Białystok School of Economics</td>
<td>Private university founded 1993 specializing in business and foreign languages. 3k students.</td>
<td>Participation in Baltic University program.</td>
</tr>
</tbody>
</table>
Annex 5: Interviewed Companies

Altogether, 25 semi-structured interviews were undertaken (5 in Walbrzych, 10 in Podlaskie, 10 in Lodzkie). The selection of stakeholders for interviews was based on several criteria:

- economic power was (turnover, growth rate);
- activity in intellectual property protection (number of patents);
- participation in innovation projects (European Commission Framework Programs such as Horizon2020);
- start-up and young companies with venture capital (VC) funding, and companies participating in innovation competitions.

Table 33. List of interviewed stakeholders in the three Polish regions

<table>
<thead>
<tr>
<th>Number</th>
<th>Company name</th>
<th>Region</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pulpack Sp. z o.o.</td>
<td>Lodzkie</td>
<td><a href="http://www.pulpack.pl/">www.pulpack.pl/</a></td>
</tr>
<tr>
<td>2</td>
<td>CERI International Sp. z o.o.</td>
<td>Lodzkie</td>
<td><a href="https://ceri.pl">https://ceri.pl</a></td>
</tr>
<tr>
<td>3</td>
<td>SkyHub</td>
<td>Lodzkie</td>
<td>skyhub.lodzkie.pl</td>
</tr>
<tr>
<td>4</td>
<td>Bilberry Automation Sp. z o.o.</td>
<td>Lodzkie</td>
<td><a href="https://bilberry.pl/">https://bilberry.pl/</a></td>
</tr>
<tr>
<td>5</td>
<td>Olympus Sky Technologies S.A.</td>
<td>Lodzkie</td>
<td>olympusky.com</td>
</tr>
<tr>
<td>6</td>
<td>Fast Logic Sp. z o.o.</td>
<td>Lodzkie</td>
<td>fastlogic.pl/</td>
</tr>
<tr>
<td>7</td>
<td>BioNanoPark Incubator</td>
<td>Lodzkie</td>
<td>bionanopark.pl/</td>
</tr>
<tr>
<td>8</td>
<td>NapiFeryn BioTech Sp. z o.o.</td>
<td>Lodzkie</td>
<td><a href="http://www.napiferyn.pl/">www.napiferyn.pl/</a></td>
</tr>
<tr>
<td>9</td>
<td>Eurofins Polska Sp. z o.o.</td>
<td>Lodzkie</td>
<td><a href="https://www.eurofins.pl">https://www.eurofins.pl</a></td>
</tr>
<tr>
<td>10</td>
<td>MORATEX Institute of Security Technologies</td>
<td>Lodzkie</td>
<td>moratex.eu</td>
</tr>
<tr>
<td>11</td>
<td>Metal Processing Cluster</td>
<td>Podlaskie</td>
<td>metalklaster.pl</td>
</tr>
<tr>
<td>12</td>
<td>Technology Applied Sp. z o.o.</td>
<td>Podlaskie</td>
<td>technology-applied.com</td>
</tr>
<tr>
<td>13</td>
<td>Expertteam Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="http://www.e-experteam.com">www.e-experteam.com</a></td>
</tr>
<tr>
<td>14</td>
<td>White Hill Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="https://whitehill.eu/">https://whitehill.eu/</a></td>
</tr>
<tr>
<td>15</td>
<td>Elastic Cloud Solutions Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="http://www.elastic365.com">www.elastic365.com</a></td>
</tr>
<tr>
<td>16</td>
<td>LPGTECH Sp. z o.o.</td>
<td>Podlaskie</td>
<td>lpgtech.eu/</td>
</tr>
<tr>
<td>17</td>
<td>Biuro Handlowe Netto Plus Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="https://netto.net.pl/">https://netto.net.pl/</a></td>
</tr>
<tr>
<td>18</td>
<td>ChrM Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="https://chm.eu/">https://chm.eu/</a></td>
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<tr>
<td>19</td>
<td>LOHR Polska Sp. z o.o.</td>
<td>Podlaskie</td>
<td>lohrpolska.pl/</td>
</tr>
<tr>
<td>20</td>
<td>InConTech Sp. z o.o.</td>
<td>Podlaskie</td>
<td><a href="http://www.incontech.pl/">www.incontech.pl/</a></td>
</tr>
<tr>
<td>21</td>
<td>Wagonys Swidnice S.A.</td>
<td>Walbrzych subregion</td>
<td><a href="https://www.greenbrier-europe.com/production/swidnica/">https://www.greenbrier-europe.com/production/swidnica/</a></td>
</tr>
<tr>
<td>22</td>
<td>Beyster Sp. z o.o.</td>
<td>Walbrzych subregion</td>
<td><a href="http://www.beyster.com.pl/">www.beyster.com.pl/</a></td>
</tr>
<tr>
<td>24</td>
<td>Sonel S.A.</td>
<td>Walbrzych subregion</td>
<td><a href="https://www.sonel.pl/">https://www.sonel.pl/</a></td>
</tr>
<tr>
<td>25</td>
<td>T-park</td>
<td>Walbrzych subregion</td>
<td><a href="http://www.darr.pl/pl/park-technologiczny-t-park">www.darr.pl/pl/park-technologiczny-t-park</a></td>
</tr>
</tbody>
</table>
Annex 6: Policy Instruments Mapping

This annex maps existing SME, innovation and entrepreneurship support instruments available both on the national and regional level for SMEs in selected three Polish regions: Lower Silesia, Lodzkie, and Podlaskie. The mapping is based on the review of literature, public documents, and the interviews.

The following criteria for including the instruments in the mapping were applied:

- Instruments that directly support SMEs by at least one component and use public budget (i.e. government or from international developing agencies);
- Instruments that indirectly support SMEs through public inputs (e.g. the provision of access to information services);
- Instruments that support creation and survival of new ventures and entrepreneurship (e.g. supporting potential entrepreneurs (students) via incubators/accelerators housed in public universities, social entrepreneurship);
- Instruments that exist in the 2014-2020 EU financial perspective (but not necessarily financed from the EU funds);
- Instruments managed at the national and regional levels;
- Instruments that include applied research or research launched with a commercial orientation and/or for promoting business innovation (in cases where instruments focus on science, technology, and innovation).

Table 34. List of national and regional instruments in the three Polish Regions

<table>
<thead>
<tr>
<th>Institution</th>
<th>Regional/national</th>
<th>Instrument full name</th>
<th>Short description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Fast track for SMEs</td>
<td>Grants for industrial research, developmental works, and pre-implementation activities.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Pilot lines</td>
<td>Grants for developmental works related to creation of large pilot lines aimed to provide information about industrial efficiency of a particular innovation.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Sectoral programs</td>
<td>Grants for industrial research, developmental works, and pre-implementation activities.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>BRIdge Alfa</td>
<td>Equity investment in firms implementing R&amp;D projects in Proof of Principle and Proof of Concept phase and creating spin-offs to increase further chances for private capital investments.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>BRIdge CVC; part of BRIdge VC</td>
<td>Equity investments in companies engaged in R&amp;D activities through financial institutions managing venture capital funds.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Strategic research programs for economy</td>
<td>Grants for R&amp;D projects, that were shortlisted by public administration or</td>
</tr>
</tbody>
</table>

97
<table>
<thead>
<tr>
<th>NCBR</th>
<th>National</th>
<th>Regional science-research agendas</th>
<th>Grants for R&amp;D works carried out by regional science-industry consortiums that are aligned with local smart specializations and general development of the region.</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Innovative methods for research management</td>
<td>Grants for R&amp;D projects in strategic sectors of the economy, carried out by geographically dispersed research teams through Virtual Research Institutes.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Application projects</td>
<td>Grants for commercialization of R&amp;D works in consortiums of enterprises, universities and research institutes with significant innovative potential.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Biostrateg</td>
<td>Grants for research on environment &amp; agriculture and preparation of implementation of results of R&amp;D works.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: CuBR IV</td>
<td>Grants for R&amp;D projects with implementation strategy focused on developing solutions for independent metal industry.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: CyberSecIdent</td>
<td>Grants for R&amp;D works and implementation of innovative technological solutions in the area of cybersecurity (with purchase of necessary R&amp;D equipment).</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Gospostrateg</td>
<td>Grants for socio-economic research aimed to support policymakers on regional and national level.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Innowacje Społeczne</td>
<td>Grants for R&amp;D projects and implementation of its results for consortia including NGOs in order to tackle social challenges.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Lider</td>
<td>Grants for R&amp;D projects with importance for economy carried out by young scientists, supporting their cross-sectoral mobility.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Panda 2</td>
<td>Grants for covering costs of maintenance of R&amp;D infrastructure purchased over the course of implementation on POIE 2007-2013 projects.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: StrategMed</td>
<td>Grants for R&amp;D projects and implementation of its results in the area of civilization diseases and regenerative medicine.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Tango</td>
<td>Grants for commercialization of the effects of basic research projects financed by selected programs of National Science Centre.</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>National programs: Techmatstrateg</td>
<td>Grants for research on modern material technologies and preparation of implementation of results of R&amp;D works.</td>
</tr>
<tr>
<td>-----------</td>
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<td>-----------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NCBR</td>
<td>National</td>
<td>Increasing staff potential in R&amp;D sector</td>
<td>Grants for development of human resources for the purpose of innovative industries.</td>
</tr>
<tr>
<td>MPiT DDI</td>
<td>National</td>
<td>Promoting Polish brands</td>
<td>Open innovation instruments for global promotion of Polish brands.</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>National</td>
<td>Open innovations - support of technology transfer, component I</td>
<td>Building comprehensive system for supporting technology transfer in open innovation formula.</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>National</td>
<td>Open innovations - support of technology transfer, component II</td>
<td>Public capital introduction to venture capital funds, which invest in companies developmental works based on technologies possessed in open innovation formula, especially in OPSG Measure 2.2.1.</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>National</td>
<td>Investments in innovative start-ups</td>
<td>Support for development of instruments alternative to bank credits dedicated to innovative start-ups (e.g. seed capital, venture capital, loans). Moreover costs of entering capital markets to be covered (e.g. stock exchange, NewConnect, Catalyst). Selection and public capital introduction to seed capital and venture capital funds, which are searching for projects in proof of principle phase or innovative start-ups.</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>National</td>
<td>Group investments by business angels in SMEs</td>
<td>Selection and public capital introduction to business angels networks, which aimed at group capital investments in companies running based on innovative solutions.</td>
</tr>
<tr>
<td>PFR Ventures</td>
<td>National</td>
<td>Competitive Polish Innovative Fund of Funds (KOFFI)</td>
<td>Creation and public capital introduction to the fund of funds, to invest in venture capital funds, which support companies running R&amp;D activities.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Proinnovative BEI services for SME</td>
<td>Grants for pro-innovation services offered by BEI and initial investment of these institutions.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Innovation vouchers</td>
<td>Vouchers for generating innovation solutions (technological, organizational, marketing-related).</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Internationalization of the Key National Clusters</td>
<td>Internationalization of Key National Clusters portfolio; stimulating international networking.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Industrial property protection</td>
<td>Grants for patent processing and preparing for commercialization.</td>
</tr>
<tr>
<td>Funding Body</td>
<td>Level</td>
<td>Initiative</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>-------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Design for entrepreneurs</td>
<td>Grants for BSI services in the area of design and brand management with necessary investments.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Acceleration programs</td>
<td>Support for creation of acceleration programs.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Polish Technological Bridges</td>
<td>Open innovation instruments for acceleration and internationalization of SMEs.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Supporting SMEs promotion of products brands</td>
<td>Grants for global promotion.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Platforms to enhance start of the new ideas</td>
<td>Grants for starting-up and acceleration of innovative companies.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Start-ups development in Eastern Poland</td>
<td>Grants for starting production and entering market.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Internalization of SMEs</td>
<td>Grants for entering foreign markets.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Innovations implementation by SMEs</td>
<td>Grants for implementation of R&amp;D works results.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Creating 'networked products' by SMEs</td>
<td>Grants for creating products, which builds-up on region heritage and potential.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Recipe for competitiveness</td>
<td>Grants for audit and implementation of design strategy for products offered by companies.</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Supporting SMEs entry to capital markets</td>
<td>Covering costs of entering capital markets (e.g. stock exchange, NewConnect, Catalyst).</td>
</tr>
<tr>
<td>PARP</td>
<td>National</td>
<td>Research for the market</td>
<td>Grants for implementation of R&amp;D works results.</td>
</tr>
<tr>
<td>BGK</td>
<td>National</td>
<td>Credit for technological innovations</td>
<td>Credits for implementation of R&amp;D works results.</td>
</tr>
<tr>
<td>BGK</td>
<td>National</td>
<td>Guarantee fund for innovative companies support</td>
<td>Guarantees for implementation of R&amp;D works results.</td>
</tr>
<tr>
<td>OPI</td>
<td>National</td>
<td>Development of hi-tech research infrastructure for science sector</td>
<td>Grants for public science entities for purchasing R&amp;D infrastructure necessary to provide services for enterprises.</td>
</tr>
<tr>
<td>Lower Silesia MO</td>
<td>Regional</td>
<td>ROP: Strengthening R&amp;D and implementation potential of universities and research institutions</td>
<td>Grants for public science entities for purchasing R&amp;D infrastructure necessary to provide services for enterprises.</td>
</tr>
<tr>
<td>Lower Silesia MO</td>
<td>Regional</td>
<td>ROP: Innovative firms</td>
<td>Grants and vouchers for enterprises for implementation of R&amp;D projects, purchasing of R&amp;D infrastructure and pro-innovative BSI services.</td>
</tr>
<tr>
<td>Lower Silesia MO</td>
<td>Regional</td>
<td>ROP: Entrepreneurship development</td>
<td>Grants for enterprises for BSI services in the area of management support and obtaining external sources of financing.</td>
</tr>
<tr>
<td>Region</td>
<td>Level</td>
<td>ROP: Services/Projects</td>
<td>Grants for enterprises/BSIs</td>
</tr>
<tr>
<td>-----------------</td>
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<td>---------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Lower Silesia</td>
<td>Regional</td>
<td>ROP: Companies internationalization</td>
<td>Grants for enterprises for BSI services in the area of internationalization and creation of new business models</td>
</tr>
<tr>
<td>MO</td>
<td></td>
<td>ROP: Product and services development in SMEs</td>
<td>Grants and credits for improvement or creation of new products/services and implementation of results of R&amp;D works.</td>
</tr>
<tr>
<td>Lodzkie MO</td>
<td>Regional</td>
<td>ROP: Development of public R&amp;D infrastructure</td>
<td>Grants for public science entities for purchasing R&amp;D infrastructure and intangible assets necessary to provide services for enterprises.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Enterprise R&amp;D infrastructure</td>
<td>Grants for enterprises for purchase or improving existing research and development facilities of R&amp;D infrastructure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Business R&amp;D projects</td>
<td>Grants for enterprises for carrying out R&amp;D works and/or purchase of pro-innovative service from BSI.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Professionalization of BSI</td>
<td>Grants for professionalization of BSI services, provision of BSI services for companies in a demand-driven model and incubation of new companies.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: SME business models</td>
<td>Grants for enterprises for internationalization and creation of new business models.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Innovations in the SME sector</td>
<td>Grants for implementation of R&amp;D works results.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Financial instruments for the SME sector</td>
<td>Loans for general development of companies.</td>
</tr>
<tr>
<td>Podlaskie MO</td>
<td>Regional</td>
<td>ROP: Increased marketization of R&amp;D projects</td>
<td>Grants for public science entities for purchasing R&amp;D infrastructure necessary to provide services for enterprises.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Business R&amp;D projects and support of the transfer of knowledge, innovations, technologies and commercialization of results of R&amp;D projects</td>
<td>Grants for purchase of R&amp;D infrastructure, R&amp;D works and implementation of its results.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Voucher for research services</td>
<td>Vouchers for purchase of pro-innovative services provided by BSIs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Investment support for enterprises</td>
<td>Grants and credits for general development of SMEs (implementation of new products/services, non-R&amp;D innovations and purchase of ICT equipment).</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROP: Promotion of entrepreneurship and increasing of investment activity of the region</td>
<td>Grants for professionalization of the BSI and necessary investments.</td>
</tr>
</tbody>
</table>
Annex 7: CTT Survey

Name of responding Public Research Organization (PRO):

1. Commercialization resources
Please give some basic informational about the groups who support Technology Commercialization and their resources and tasks. If you have both a CTT (Centre for Technology Transfer) and an SPC (Special Purpose Company) then complete both tables.

<table>
<thead>
<tr>
<th>TTO</th>
<th>Please describe briefly</th>
</tr>
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<tbody>
<tr>
<td>Primary responsibilities of the CTT</td>
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</tr>
<tr>
<td>Main tasks and activities of the CTT</td>
<td></td>
</tr>
<tr>
<td>Number of employees (Full Time Equivalents)</td>
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</tr>
<tr>
<td>Number of FTE with a scientific/engineering or research background</td>
<td></td>
</tr>
<tr>
<td>Number of FTE with a business commercial background</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>SPC</th>
<th>Please describe briefly</th>
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<td>Primary responsibilities of the SPC</td>
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<tr>
<td>Main tasks and activities of the SPC</td>
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<td>Number of employees (Full Time Equivalents)</td>
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<td>Number of FTE with a scientific/engineering or research background</td>
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<tr>
<td>Number of FTE with a business commercial background</td>
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</table>

<table>
<thead>
<tr>
<th>CTT/SPC tasks (please use an X to indicate how often the staff is engaged in these tasks)</th>
<th>Regular</th>
<th>Occasional</th>
<th>Rare/ Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scouting for new technologies in the R&amp;D base.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Registering invention disclosures.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supporting the protection process (patent drafting and filing).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valuing patents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessing technology strengths.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Exploring the market and identifying potential technology adopters.
Promoting technology to adopters.
Negotiating patent/ know-how licensing deals.
Preparing new spin-off companies.
Searching for equity investment (risk finance).
Running training courses about Technology Transfer for the research base.
Searching for commercial partners for joint research projects.
Searching for commercial partners for contract research using ‘ancillary’ services (equipment and PRO facilities).
Managing the Enterprise Europe Network
Writing EU/ national grant proposals for the University/ researchers
Other (please outline)

Skills enhancement

Please suggest 3 areas from the above list (including ‘other’) where you feel that the CTT/ SPV staff would benefit from enhanced skills training and capacity building.

2. Innovation Outputs

Please summarize your recent Technology Transfer results (3 year period if possible).

<table>
<thead>
<tr>
<th></th>
<th>2017</th>
<th>2016</th>
<th>2015</th>
</tr>
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<tbody>
<tr>
<td>Number of national patent applications</td>
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<td></td>
</tr>
<tr>
<td>Number of granted national patents</td>
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<tr>
<td>Number of EPO patent applications</td>
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<tr>
<td>Number of EPO granted patents</td>
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<tr>
<td>Number of PCT applications</td>
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<tr>
<td>Number of licensing deal concluded</td>
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<tr>
<td>Total Annual Value of licensing deals</td>
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<tr>
<td>Number of research contracts signed with an enterprise partner</td>
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<tr>
<td>Total Annual Value of the research contracts</td>
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<tr>
<td>Number of enterprises who made use of contract research services (ancillary use of equipment and facilities)</td>
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<tr>
<td>Total Annual Value of the ancillary use of equipment contracts</td>
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<tr>
<td>Number of spinoff companies annually (SPC and/or PRO holding an equity stake)</td>
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<tr>
<td>Total Annual Value of equity investment into the spinoffs</td>
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</tbody>
</table>
3. Success Stories

Can you briefly describe a significant commercialization success story for the university in the last 5 years (either licensing or start-up/ spin-off)? This might relate to how the commercialization has generated revenue for the university or to its expected longer-term impact on the local economy (e.g. job creation, revenue generation), benefit to society or for the environment. It might also capture significant learning for the university or its research or commercialization units in how to improve processes, skills and outcomes of Technology Transfer activities e.g. building longer term strategic partnerships for contract research activity.

4. Strategic Partnerships

Please list up to 3 external commercial partners who the university has worked with in recent years and who might be willing to be interviewed as part of the project. It would be helpful if they highlight different activities e.g. a licensee of technology, long term research collaborator and an enterprise making use of the specialized equipment e.g. for regular / routine testing.
Appendix 2. Concept notes for the regional pilots

2A. Podlaskie Region

Objectives of the pilots

- The main objective of the pilots in Podlaskie is to leverage the limited human and financial resources through collaboration of universities and research organizations, building a critical mass of technology transfer expertise and capacity.
- The secondary objective is to leverage the 20% ancillary use of equipment to start a collaboration with industry with a potential to upgrade this cooperation in the long-run.
- The final objective is to support proof-of-concept projects, which were not successful in nation-wide programs, yet have potential impact on the region.

The objectives are addressed by two main pilots:

- Pilot A: Setting up “Partnership for University-Industry Cooperation” joint undertaking, which would organize joint activities and leverage expertise and capacity of individual universities in technology transfer and commercialization
- Pilot B: Designing and introducing a local proof-of-concept (PoC) support program, helping to increase Technology Readiness Level of technologies at HEI.

Rationale (justification of the selected approach):

The region’s universities suffer from limited technical and financial resources when it comes to research commercialization and cooperation with companies in general. As was identified in the analytical report, the Podlaskie region has a rather “limited potential of research and insufficiently developed scientific cooperation with other units in the R&D area in the country and abroad”. At the same time, the companies in the region often do not invest in long-term innovations, and thus they are less motivated to cooperate with universities. The region can be considered as “organizationally thin” – there is a limited number of strong stakeholders, especially at the supply-side. Thus, it is important to build a critical mass of commercialization capacity through collaboration and cooperation of the region’s universities, within and with local enterprises and clusters.

Despite exceptions, the cooperation between firms and universities in Podlaskie is limited to routine measurements and specialized tests. Companies very rarely want to cooperate with universities on long term projects. At the same time, the equipment at universities is often underused. This mismatch is caused by the lack of transparent and easy-to-find information. Unclear rules also complicate the use of the equipment at universities. Besides the 20% ancillary use of R&D equipment creating revenue for universities, this rather simple cooperation is often the first step for cooperation with bigger added value.

Universities in Podlaskie do not have enough internal capacity (expertise, money, time) to develop prototypes and ultimately products, which could be market ready for commercialization.

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80 Regions, where there are not enough actors capable of innovation, which is typical for rural areas (Tödtling, F. and Trippl M. (2005): One size fits all? Towards differentiated regional innovation policy approach. Research Policy 34, 1203-1219.)
though some of the regions’ projects have often an application potential, they are not very successful in the nation-wide proof-of-concept competitions. However, even though limited, there are several research areas with relevant application potential. The analytical report finds that universities in Podlaskie have strong expertise in Medical Technology. Ideally, a small but targeted local PoC support program (eligible for Podlaskie universities only) could help leverage local expertise and develop prospective technologies into technologies or spin outs with market potential.

The SWOT below captures the main weakness and potentials of the region.

### SWOT of Podlaskie regional innovation ecosystem

<table>
<thead>
<tr>
<th>STRENGTHS</th>
<th>WEAKNESSES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• State-of-the-art specialised equipment at universities</td>
<td>• Low level of trust between private companies and PROs</td>
</tr>
<tr>
<td>• Metal Processing Cluster and BPN-T as notable local innovation assets</td>
<td>• Limited research potential (number and quality on outputs)</td>
</tr>
<tr>
<td>• Expertise in medical technologies and related fields (overlap between demand-side and supply-side)</td>
<td>• The limited capacity of companies to innovate (organizationally thin region)</td>
</tr>
<tr>
<td>• Universities willing to cooperate and the presence of a strong leader (BUT)</td>
<td>• A systematic approach to TT at universities is missing including the accessibility to relevant information (equipment, expertise, IP)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OPPORTUNITIES</th>
<th>THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Capitalise on the supporting infrastructure and Metal Processing Cluster, which can lead by example</td>
<td>• Further alienation between companies and PROs due to lack of best practice examples</td>
</tr>
<tr>
<td>• Utilise the expertise of the medical-related sector</td>
<td>• Talent outflow (brain drain)</td>
</tr>
<tr>
<td>• Use the existing specialised equipment (there is a demand, confirmed during all interviews)</td>
<td>• Fail to use the state-of-the-art equipment and not being able to buy new equipment in future it (losing strong advantage)</td>
</tr>
<tr>
<td>• Innovate the strongly present agricultural and food-related sector</td>
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</tbody>
</table>

### Summary pilot description

**Pilot A: Setting up “Partnership for University-Industry Cooperation” joint undertaking**

*The Partnership for University-Industry Cooperation* is a joint undertaking of universities and research organizations from the Podlaskie region. It will take the form of a partnership without a legal subjectivity. One of the members of partnership is expected to act as a leading partner, coordinating all activities. The Bialystok University of Technology (BUT) is suitable for this initial role due to its experience and track record in technology transfer. The partnership should include non-academic actors such as local clusters or S&T parks (such as BPN-T) including the Metal Processing Cluster, which is often perceived as a best practice example in the region. From the academic side, only three biggest

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81 Such as TANGO offered by NBCR; only one project from Podlaskie (at Medical University) was supported from TANGO with a fraction (0,2 %) of the overall programme allocation (POL-on database).
universities will participate (BUT, UB, MUB) at the beginning of this initiative. Other HEI can join the partnership after it is successfully piloted, processes and activities tested, and responsibilities of all participating parties settled.

The Partnership will be guided by an advisory board which includes representatives from the major ecosystem stakeholders (university rectors, cluster representatives, major firms, the Tech Park) as well as representative of a national innovation support institution (ex. NCBR/PARP). The advisory board will monitor the quality and progress of the work and provide guidance on the planned activities. This board will also help to evaluate the pilot program after it is finished.

The main objective of this Partnership is to build stronger and closer relationships among universities and with local firms and industries. To achieve this, it will organise joint activities, which will lead to increased cooperation between universities and companies. Universities will be able to leverage their capacities to increase their economic impact in the region. The joint activities should also help increase the mutual trust between universities and companies, which the analytical report identified as one of the main obstacles for cooperation.

The activities organized by the Partnership are aimed at establishing connections, improving communication, and building mutual trust. They will also lead to better understanding of “the other side”, which is often an obstacle for cooperation. Crucially, it will help HEI to understand challenges industry is facing and focus on problem/challenge-driven research.

Proposed activities within the Partnership

- **Speed dating/business breakfast.** These events could effectively set balanced expectations among universities and companies; importantly, it is expected to increase mutual trust\(^2\). Speed dating in this context is understood as a networking event, where university researchers, professors, and students meet companies and communicate possibilities for cooperation. The main goal is not to introduce new contacts, but for HEI to better understand the business perspective and challenges companies face, and vice versa. To increase the impact of such events, it is useful to organise the events along specific challenges or topics.

- **Joint database of R&D equipment and expertise at universities:** One of the key advantages of the regions’ universities is the unique and modern equipment purchased from the Structural Funds. Also, companies indicated (see the Analytical report) that they would like to use this equipment more. However, information about this equipment is very limited and fragmented. Companies approach and communicate with each university separately rather than a single-point-of-access. The Partnership itself can function as such a contact point. However, to abide by the provisions for 20% ancillary use of the R&D equipment, a user-friendly IT system (database, monitoring, booking) can be created. A professional technical (IT) solution could be developed or licensed. Besides equipment, it would be useful to map expertise of researchers since specific expertise is needed to operate the equipment. Moreover, the goal is not to sell the machine time, but to start-up some cooperation thanks to utilizing the equipment; hence it is important to include expertise of researchers on top of the mere evidence of equipment.

- **Communications:** The analytical report indicates that companies would like to cooperate with universities, but they do not know what they offer and what to do to start the cooperation.

Thus, universities’ internal capacities could be better shared/communicated to overcome this information gap. These capacities include joint use of communication channels with industrial partners, marketing of expertise, and joint communication of offer towards the industry. Besides communications and marketing-related capacities, universities can evaluate their intellectual property (IP) portfolio and market the most promising IP jointly to maximise impact. This can be done through the joint database of R&D equipment and expertise.

- **Capacity building**: According to the interviews, universities understand their technology transfer-related expertise as insufficient. Thus, the Partnership could organize and deliver joint capacity building activities. These activities could be organized utilising internal capacities of individual universities (sharing knowledge), but external experts might be invited as well. The key expertise missing, as identified in the survey, is searching for commercial partners for contractual research (exploring the market and sales in general).

- **Entrepreneurial training**: Given the lack of entrepreneurial activities in the region, especially science and technology-based startups, the Podlaskie region struggles with a lack of entrepreneurial talent and talent outflow (brain drain). Thus, capacity building activities should not be limited to researchers and technology transfer experts, students should be targeted as potential entrepreneurs. Developing entrepreneurial skills could be achieved through delivering focused trainings on: business plan preparation, human centred design, investment readiness, pitching for investors (including mock pitches), financial planning, market research and segmentation, marketing etc. Such trainings could be delivered to university students through local or national entrepreneurship support intermediaries (supported by the Partnership/ROP). This activity can be inspired by Stanford’s d.school, which helps students to unlock their creative potential and help them to have an impact in the world, especially in their business experience.

- **Network of business experts**: Beside partnership of HEI, an informal network of business experts would help to integrate business and academic community. The network might advise HEI on business aspects of cooperation between universities and industry (such as bringing business challenges to the fore of interest of researchers when preparing research projects), help to evaluate the technologies (such as within committee selecting PoC projects to be supported) etc. The business experts would benefit from the early knowledge of promising technologies.

Given the limited time and resources for the pilot, the focus should be given to activities, which are not very costly and yet they have a significant impact. Thus, speed dating/business breakfast and joint database of R&D equipment and expertise is discussed in greater detail in other sections.

*Speed dating/business breakfast*

Speed dating events could effectively set balanced expectations among universities and companies; importantly, it is expected to increase mutual trust. Speed dating in this context is understood as a networking event, where university researchers, professors, and students meet companies and communicate possibilities for cooperation. However, the main goal is not to meet, but to exchange
information about challenges companies face and HEI’s relevant expertise suitable to address these challenges. These meetings should help HEI to focus on problem/challenge driven research.

In Podlaskie, the analytical report has identified several promising fields for technology transfer, such as Medical technology or Manufacture of machinery and equipment. These topics are suitable for pilot speed dating events; they have the biggest potential to be successful, thus motivate both universities and companies to organize other similar events in the future. Moreover, the topics should be formulated across specific challenges to help organizers to select the right researchers with suitable expertise. The choice of the right theme, selection of companies and selection of researchers is crucial for the speed dating to be successful.

One of the most effective types of speed dating event in the context of university-business collaboration is a “roundtable” version. The event is supposed to be organized along a specific topic (such as medical devices, IoT, industry 4.0, etc.). In this version, around five people and a moderator are seated at several tables. Each participant at the table has two minutes to introduce himself/herself and mention areas of expertise (typically academic participant) or expertise he/she is looking for (business participant). It is useful if the event starts with a short (15 minutes) presentation about current trends in the main theme of the speed dating delivered by a respected expert in the field.

The event has two parts separated by a coffee break. The first part of the speed dating (roundtable) is followed by an informal networking with refreshments. The best time to organize this event is early afternoon in the middle of a week (due to availability of participants, especially those from businesses) with duration of approximately two hours of the formal part of the event. The total number of participants should be between 20 and 25, plus a moderator at each table. The most suitable moderators are usually technology scouts; they can help researchers with communication with business counterparts and gather demand from companies. It is important that after the event the technology scouts (or a similar role) actively push both the researcher and the businessman to move forward in the cooperation helping both side in the process. Without this active role, the speed dating often fades out. Based on experience, BUT might be responsible for organizing these events with cooperation with other two HEI and BPN-T (offering a venue).

One of the most important aspects is to select the right participants, both from academia and from business. Usually, one half of participants are representatives of businesses and the second half representatives of academic research. Researchers should be from HEI in the region; they are selected by technology scouts or someone else with a similar role (such as SPCs). The core of the participants from the business side should be from the region. However, participation of companies outside the region is sometimes necessary, especially when there are not enough suitable companies in a certain topic in the region. Importantly, companies with sufficient R&D and innovation “absorptive capacity” need to be selected. In other words, these companies need to understand the importance of innovation and have some experience with R&D. Moreover, it is necessary that these companies are willing to cooperate with HEI in the innovation process.

To maximize the impact of the event, the documents with basic description of all participants should be compiled and distributed before the event. This information should include the following: name of the organization, name of the participant, introduction (who I am), what I can offer, what I am looking for. This information must be succinct and should not exceed half a page. The second half of the page will serve for notes for participants.
Joint database of R&D equipment and expertise at universities

One of the key advantages of the HEI in the region is the unique and modern equipment purchased from the Structural Funds. Also, companies indicated (see the Analytical report) that they would like to use this equipment more. However, information about this equipment is very limited and fragmented. Companies approach and communicate with each university separately, single-point-of-access is missing. The Partnership itself can function as such a contact point. However, to abide by the provisions for 20% ancillary use of the R&D equipment, a user-friendly IT system (database, monitoring, booking) needs to be created.

HEI will report relevant equipment for business collaboration to the entity which will manage a specific database. Each HEI will provide information about the field of use or type of service, which can be offered. The offer should be attractive to business not only describing the equipment. The easiest way how to provide this information is through a specific IT tool. The tool must be simple and easy to use. IT system should be managed by an external authority, which will ensure the updates of data, SW updates, etc. The external company developing the tool (or offering a license) will be selected in an open public tender if necessary. It is expected that the database will be managed (in terms of data) by the Partnership, led by BUT. However, the during the pilot the data will be collected and proposition towards industry prepared without integrating them into the IT tool/software. Only after the pilot is concluded, and if the activity is successful (positive feedback from industry), the software can be prepared in a subsequent (bigger, longer) project.

Besides research equipment, the database will contain data on HEI experts and their expertise and research outcomes. This information can be gathered from public databases. In Poland, this information can be provided by the National Information Processing Institute\(^5\). The database would work the best, if the researchers active in collaboration would be able to edit this database and add information about their research. These data can complement data on available equipment with relevant expertise of academic experts. See Experts.ai platform\(^6\) for such an example employing data from Czechia.

Pilot B: Proof-of-concept Pilot support program

The PoC program is intended to provide financial support to technological projects with commercialisation potential, which were not selected for funding in nation-wide (such as TANGO program run by NCBR) or European competitions. The program is aimed at researchers and research teams from the Podlaskie region universities and research organization. The support will target projects, which were not selected in the nation-wide schemes, but received above threshold score in the initial evaluation and were not supported due to limited allocation\(^7\).

The PoC program will be run the Partnership for University-Industry Cooperation. The PoC program can be also managed through a specific project if it proves to be more suitable towards ROP rules and administration. The PoC program can leverage the initial evaluation results from the targeted schemes for support. The Partnership for University-Industry Cooperation is expected to source projects,


\(^6\) [https://experts.ai/](https://experts.ai/)

\(^7\) If the combined budget of all project submitted to the PoC programme is higher than the overall allocation, the projects will be ordered according to the evaluation of the initial projects and a cut-off will be introduced.
encourage the local universities to take part in this program, especially along the regional specializations (such as suggested in the Analytical report or as quoted in the Regional Innovation Strategy).

The PoC program will have a specific maximum financial allocation (around 20,000 EUR per project). The eligible expenditures are assessed according to the rules of the initial targeted program. All supported projects will have to secure endorsement/a letter of intent form at least one local company, cluster, or investor declaring interest in collaborating on the technology/prototype.

**Besides co-financing the nation-wide schemes, projects of significant regional importance will be selected.** The project will have to address one of the priority topics as selected by the Partnership for University-Industry Cooperation. Priority topic could emerge from the findings of the analytical report (such as Medical technologies); they have to correspond with the priorities mentioned in the Regional Innovation Strategy and they have to reflect business needs. Proposed projects will need to demonstrate interest from private sector parties or investors (official endorsement of at least one private company declaring interest in the technology/product being developed).

**HEI participating in the project (or Partnership if it is organized through the Partnership) will nominate the projects for financing.** There will be a committee of local/national experts evaluating the projects according to a set of specific criteria. Criteria from similar projects (such as TANGO by NCBR) will be used. Within this second strand of PoC program (projects of significant regional importance), projects with lower TRL can participate; this aspect need to be reflected in the rules of the program. The members of the committee will be selected jointly by the participating partners. Metal Processing Cluster and BPN-T are expected to be members of such a committee; there will be experts from outside Podlaskie (representing more than 50% of votes) in the committee to ensure impartiality. The committee meetings are moderated by BUT or the partner leading the PoC program project.

The PoC program will have a specific maximum financial allocation (around 20,000 EUR per project). The eligible expenditures need to be specified. However, similar to the evaluation criteria, rules from existing or former similar project should be used. All projects will have to secure endorsement/a letter of intent form at least one local company, cluster, or investor declaring interest in collaborating on the technology/prototype.

**Target group**

- **HEI**

The primary target group within HEI are CTTs. They will take part in the networking activities, share capacities, build skills, identify PoC individual projects with the biggest potential etc. The secondary target group within HEI is students. Their education in business-related and technology transfer-related skills could improve the network building within innovation ecosystem.

- **Local businesses and investors**

Local businesses should take part in the networking activities prepared by the Partnership joint undertaking, such as speed dating. They will also take part in the industrial committee assessing the PoC projects of significant regional importance. Moreover, they are expected to benefit from the
access to R&D equipment available at universities and potentially the expertise of university experts (contractual research, licensing IP). Local businesses might be organized in an informal network.

- **Researchers and research teams**

Researchers will take part in the networking activities with companies (such as speed dating) and they will have an opportunity to finance their proof-of-concept projects through the PoC program.

**Pilot A (Partnership) Target Group**

**Speed dating/business breakfast**

- Companies from the region (plus several companies outside the region if needed when there is a possibility for relocation of setting-up a branch office in the region) in a specific field with sufficient R&D and innovation “absorptive capacity”. Typical (and the most suitable) representatives of such companies are their R&D directors or CEOs. They have to be willing to cooperate with universities and should have clear understanding of the challenges their company is facing.
- Researchers with experience with cooperation with business or highly motivated to cooperated (such as you and proactive PhD students/young scientists) and with expertise in the topic, which was selected as the main theme for the speed dating/business breakfast.

**Joint database of R&D equipment and expertise**

- Businesses using the database when searching for expertise or specialized equipment; the most promising companies for cooperation (using the database) from the region include:
  - ChM, Medgal, Diagnosis from the Medical sector
  - Pronar, Jazon, AC from the Manufacture of machinery
  - Local Start-ups and spin-offs
  - Businesses outside the region with a potential for relocation or setting-up a branch in the region
- Regional HEI with research equipment and research expertise
- Researchers, who could edit their expertise (outcomes) in the platform

**Pilot B (PoC Support Program) Target Group**

The target group of the suggested activities are:

- HEI with potential to solve challenges the business faces through delivering technologies with sufficient Technology Readiness Level
- Researchers delivering proof-of-concept projects
- Companies with potential to acquire technologies from HEI
- Investors from region and elsewhere, if there is a potential to build a start-up based on a technology

**Pilot Evaluation**

Both pilots will be evaluated based on the indicators (see below). During both pilots, several key aspects should be monitored and evaluated:
• The willingness of HEI to share capacities and information.
• Feedback from companies on the activities and how they perceive impact of these activities on their business. Metal Processing Cluster will help to disseminate results and gather feedback directly at companies.
• The impact of speed dating/business breakfast and feedback on the selected model. The capacity of local companies can be an issue.
• Importance of potential software for equipment and expertise evidence. If the feedback from industry is positive, HEI is willing to share information and there is a strong leader, the software to visualize the data might significantly help with sustainability of the activity.
• Possibility of gathering offer of services (and potentially licenses offer) on top of the equipment and expertise evidence.
• The research potential at HEI to apply for PoC support, especially their Technology Readiness Levels eligible for support. Based on the TRL of research outcomes, the specific scope of the PoC program can be decided upon. There might be a need to shift the support to projects with lower TRL. Introducing phases of the program (according to the TRLs) can be an option.
• The number of individual projects available for PoC program supporting projects not successful in the nation-wide schemes; there might be too few or none.

Instrument and Financing

Pilot A (Partnership) Instrument and Financing

Partnership

Funding for the pilots is expected to be made available through the ROP. It covers mainly personnel at HEI and BPN-T to set-up the Partnership and manage its activities, including the speed dating and joint database of R&D equipment and expertise. For the Partnership to be successful, a specific person (1,0) managing all activities of the Partnership is necessary. All HEI (and BPN-T) are expected to nominate such a person.

The support will be given through ROP. Costs associated with the Partnership include:

• Personnel (approx. 80.000 – 100.000 EUR), including a specific person at BUT, UB, MUB, and BPN-T.
• Other activities such as capacity building events, networking, etc. (1.000 EUR for first 12 months).

All stakeholders will form a consortium and will apply for a project. The consortium will have a leading partner (suggested leader is BUT, its SPC respectively), who will distribute the money and foresee all planned activities.

Speed dating/business breakfast

Costs per one event will be close to zero, comprising only catering (few hundred EUR). The venue can be provided by BPN-T free of charge. All participants participate for free including the expert delivering the introductory presentation. It is important to select three to four main topics/themes and repeat speed dating in these topics (either with the same participants or with new ones) at least twice a year.
with follow-up activities (such as other types of networking, individual communication with companies) in between. Speed dating events should be linked to other technology transfer activities – for example, the joint database could be introduced during the events and other best practice examples disseminated.

The support from ROP will be given through the Partnership. It is expected that BUT (it’s SPC) will coordinate the partnership. Relevant costs in the speed dating/business breakfast activity include the following:

- Catering (approx. 200 EUR per event). Altogether approx. 1,200 EUR for the first 12 months (speed dating along three themes, twice a year, six events in total).

**Joint database of R&D equipment and expertise**

**Funding for the pilots is expected to be made available through the ROP.** The funding will help develop special IT solution and its updates for at least five years. The cost of such a database may differ significantly based on expected functionalities – the price should be between 5,000 and 15,000 EUR. Cost connected with creating marketing materials might be eligible as well. Within the pilot, the data may be gathered first and the idea of joint database tested, the IT platform developed upon success of the pilot in a subsequent project.

The support from ROP will be given through the Partnership. It is expected that BUT (it’s SPC) will coordinate the partnership.

Relevant costs associated with the joint database:

- IT tool (approx. 5,000 – 15,000 EUR) if decided relevant within the pilot.
- Marketing of equipment towards business (approx. 3,000 EUR).
- Personnel cost (financed through the Pilot A).

**Pilot B (PoC Support Program) Instrument and Financing**

**Funding for the pilots is expected to be made available through the ROP.** The funding will allocate financial resources for the PoC administration and grants (within the limits of what the MO allocates and based on demand). The support can be given through the Partnership (project consortium) or through a specific project. The BUT is expected to lead activities related to the PoC support program.

Relevant costs associated with the PoC support program:

- Administration covered from the Partnership (or not eligible if a separate project).
- Experts in the committee (approx. 5,000 EUR).
- PoC costs (80,000 EUR to support four projects in 12 months).

**Tasks and responsibilities**

**Pilot A (Partnership) Stakeholders**
**Partnership**

The roles of the key stakeholders for the main activity, the Partnership, are listed. The more granular description of roles of the key stakeholders within the concrete activities (speed dating and joint R&D database) are listed below.

**The Bialystok University of Technology**

The BUT will be acting as a chair of the Partnership, especially due to its experience and big volume of successful technology transfer example. Participation of BUT’s SPC is expected. They will be responsible for the following activities to start the Partnership:

- Organize a kick-off event to set-up the partnership.
- Chair the partnership (in future, rotating chair is a possibility).
- Nominate a person to an advisory board.
- Delegate a person (technology scout) fully responsible for the activities in the Partnership (financed by the MO). A specific person is needed to ensure the continuous communication with all participating stakeholders and ensuring the quality of all activities. The experience from elsewhere shows that without such a person it is difficult to ensure a long-term effect. Every stakeholder in the pilot is expected to delegate such a person.

**Other HEI (University of Bialystok, Medical University in Bialystok)**

- Cooperate with BUT to set-up the Partnership.
- Nominate a person to an advisory board.
- Delegate a person (technology scout) fully responsible for the activities in the Partnership (financed by the MO). A specific person is needed to ensure the continuous communication with all participating.

**Bialystok Science and Technology Park (BPN-T)**

BPN-T will act as a mediator in the pilot, helping to bring universities and businesses closer together. They will be responsible for the following activities in the pilot:

- Take part in the kick-off event as one of the founding partners.
- Host the networking activities (such as speed dating) including the kick-off at their premises. BPN-T will act as an independent stakeholder mitigating the potential problem of competitiveness of HEI, which might result in lower willingness to cooperate.
- Organize the PoC committees and offer subsequent support for the promising start-ups (if relevant).
- Delegate a person fully responsible for the activities in the Partnership (financed by the MO).

**The Marshal Office**

MO will function as a funding body and a supervisor of all activities. Its role will include the following activities:
• Responsible for financing the Partnership (financing one person per stakeholder) and some of its activities (see above). It is expected to be financed from ROP; modifications of the ROP to enable this financing are necessary.
• Delegate a person responsible for the program including its monitoring.
• Market the Partnership and its activities towards general public, including the target groups.

The Metal Processing Cluster

The Metal Processing Cluster will help to attract the businesses and increase the impact of the Partnership towards businesses. Its role will include the following activities:

• Take part in the kick-off event as one of the founding partners.
• Market the Partnership and its activities towards businesses.
• Take part in the committee for PoC projects.

Speed dating/business breakfast

The speed dating/business breakfast will be organized by the three HEI participating in the Partnership. The first event will be organized by BUT, which has the biggest relevant experience and skills. However, other HEI (UB, MUB) will participate in selecting relevant researchers for all organized events.

The Bialystok University of Technology

• Lead the selection of researchers from BUT and coordinate selection of participant across HEI.
• Prepare briefs (basic introduction documents) on academic participants from BUT a provide templates to other participating HEI.
• Coordinate selection of moderators in cooperation with BPN-T.
• Lead the follow-up activities.
• Delegate a person responsible for the speed dating/business breakfast. It might be the same person responsible for the Partnership.

Other HEI (University of Bialystok, Medical University in Bialystok)

• Selecting relevant researcher for the speed dating/business breakfast events.
• Cooperate on preparing the briefs about the participating researchers.
• Helping BUT and BPNT-T to invite relevant companies.

Bialystok Science and Technology Park

• Organize the speed dating/business breakfast events at their premises including refreshments (financed by MO). BPN-T will act as an independent stakeholder mitigating the potential problem of competitiveness between HEI, which might result in lower willingness to cooperate.
• Help HEI to communicate with businesses including invitations to speed dating events.
• Help MO to monitor the outcomes and impact.
• Use its channels to disseminate results, including social media.

The Marshal Office
• Finance the speed dating/business breakfast. It is expected to be financed from ROP through the Partnership; modifications of the ROP to enable this financing are necessary.
• Monitor the impact with cooperation with all stakeholders, BPN-T in particular.
• Market the outcomes from speed dating/business breakfast events towards general public, including the target groups.

_The Metal Processing Cluster_

• Help HEI to contact businesses and ensure their participation.
• Participate in speed dating/business breakfast events in relevant fields as moderators.
• Market the outcomes from the speed dating events towards businesses.

_Joint database of R&D equipment and expertise_

_The Bialystok University of Technology_

• Define the basic structure of the database; together with other HEI and external developer of the IT tool.
• Organize a public tender if relevant (external developer of the IT tool if relevant within the pilot).
• Manage the database from the HEI’s side.
• Coordinate the data gathering of the equipment listed in the database. Lead by example listing all its equipment.
• Delegate a person responsible for the joint database. It might be the same person responsible for the Partnership.

_Other HEI (University of Bialystok, Medical University in Bialystok)_

• Cooperate with BUT in the detailed definition of the database.
• List all of its equipment useful for cooperation with industry.
• Delegate a person responsible for the joint database. It might be the same person responsible for the Partnership.

_Bialystok Science and Technology Park_

• Help HEI to convert the list of the equipment into business-attractive proposition. Network of business expert might be used.
• Help MO to monitor the outcomes and impact.
• Use its channels to disseminate results, including social media.

_The Marshal Office_

• Finance the creation of the joint database. It is expected to be financed from ROP (through the Partnership or as a separate activity); modifications of the ROP to enable this financing are necessary.
• Monitor the impact with cooperation with all stakeholders, BPN-T in particular.
• Market the outcomes from speed dating/business breakfast events towards general public, including the target groups.
Pilot B (PoC Support Program) Stakeholders

The Bialystok University of Technology

The BUT will organize the first PoC call. Participation of BUT’s SPC is expected. They will be responsible for the following activities to implement the PoC support program:

- Select promising technologies (with sufficient TRL) eligible for the PoC call from BUT and lead by example.
- Market the program internally to increase participation.
- Advise other HEI on selecting technologies for the program (methodology for technology evaluation). Business needs will be taken into account (problem oriented projects with higher potential of commercialization should be selected).
- Delegate a person fully responsible for the PoC support program (financed by the MO, can be the same person responsible for the Partnership).

Other HEI (University of Bialystok, Medical University in Bialystok)

- Select promising technologies (with sufficient TRL). BUT and BPN-T can assist.
- Market the program internally to increase participation.
- Delegate a person responsible for the PoC. It might be the same person responsible for the Partnership.

Bialystok Science and Technology Park

- Establish a committee evaluating PoC projects of significant regional importance.
- Organize the PoC committees (host the meetings at its premises) and offer subsequent support for the promising start-ups (if relevant).
- Helping HEI to secure letters of intent from companies (helping with marketing promising technologies).

The Marshal Office

MO will function as a funding body and a supervisor of all activities. Its role will include the following activities:

- Responsible for financing the PoC. It is expected to be financed from ROP; modifications of the ROP to enable this financing are necessary.
- Monitor the impact with cooperation with all stakeholders, BPN-T in particular.
- Market the outcomes from speed dating/business breakfast events towards general public, including the target groups.

The Metal Processing Cluster

- Take part in the committee evaluating the PoC projects with significant regional importance.
- Help HEI to selected suitable technologies for PoC support program if necessary.

Risks and mitigation
Pilot A (Partnership) Risks and Mitigation

**Partnership**

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Networking and willingness to cooperate</td>
<td>Targeted outreach, networking, and media coverage should help to inform companies about opportunities created by the program (using the equipment, acquire some IP or engage university experts, single-point-of-access to universities through the Partnership). “Fieldwork” during the pilot phase and informing the relevant stakeholders is necessary.</td>
</tr>
<tr>
<td>Monetary risks</td>
<td>The budget of the pilot needs to be well planned (in the design phase) and managed. Possibilities of co-financing (sponsorship) from private companies will be researched.</td>
</tr>
<tr>
<td>Insufficient human resources</td>
<td>Even if the positions are covered, it might be a challenge to find people with suitable skills and experience. BUT and BPN-T will help to find such experts through their networks.</td>
</tr>
<tr>
<td>Legal risks (state aid)</td>
<td>The state aid risk can be mitigated by adhering to an approved monitoring methodology cleared by relevant public bodies and agencies.</td>
</tr>
</tbody>
</table>

**Speed dating/business breakfast**

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation of researcher without experience with collaboration with business</td>
<td>Proper identification of relevant researchers by technology scouts at HEI can help eliminate this risk. Also, an active marketing about the added value of such an event inside the research organization can reduce this risk.</td>
</tr>
<tr>
<td>Company representatives without executive power</td>
<td>Incorporation of clusters (like Metal Processing Cluster), business chambers (both at regional and national level) and personnel contacts of technology scouts, BPN-T and MO will help to find the right participants.</td>
</tr>
<tr>
<td>Low participation</td>
<td>Active marketing about the added value inside the research organization and with a help of clusters, business chambers etc. can reduce this risk.</td>
</tr>
<tr>
<td>Fading-out of the promising potential collaborations</td>
<td>After the end of the event organizers must help to finalize the cooperation, assisting both sides (academia and business) in the process. BUT should be leading.</td>
</tr>
</tbody>
</table>

**Joint database of R&D equipment and expertise**

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of willingness of researchers to share the equipment and their expertise</td>
<td>Leading by examples by BUT and business support from BPN-T will help to mitigate effects of this risk. Showing best practice examples of the activity from elsewhere can help as well.</td>
</tr>
<tr>
<td>Limited personnel capacities to cover higher demand from industry</td>
<td>If the joint database is actively used by industry and creates high demand for research services, the capacity at HEI can be insufficient. On the other hand, the evidence of the equipment is a</td>
</tr>
</tbody>
</table>

119
good opportunity to reach out to researchers not very active in cooperation with industry so far and help building their business skills.

Marketing activities are needed. Moreover, it is important not only list the equipment but to convert it into a business-attractive propositions. BPN-T, BUT, and business experts can help HEI to deliver this.

Pilot B (PoC support program) Risks and Mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of technologies with sufficient TRL</td>
<td>Supporting projects with lower TRL is a possibility. The pilot of the PoC can focus on pre-PoC projects, helping HEI to build a portfolio of business relevant technologies with TRL 4-5, which would then be eligible for national PoC programs or support these projects/technologies further in the regional PoC scheme. Introducing phases into the PoC program is a possibility.</td>
</tr>
<tr>
<td>Lack of skills for technology evaluation and selection for the PoC program</td>
<td>BUT and business experts will advise on the evaluation of technologies. It is possible to introduce specific capacity building activities within the Partnership to build relevant skills in the region.</td>
</tr>
<tr>
<td>Low absorptive capacity of companies from the region</td>
<td>Potential interest might be found outside the region in companies with potential to relocate or set-up a branch in the region.</td>
</tr>
</tbody>
</table>

Main counterpart

- The MO will be the main counterpart for both pilots.
- BUT (leading the Partnership and its activities).
- BPN-T.

Outputs

Pilot A (Partnership) Outputs

**Partnership**

The following outputs are anticipated from the pilot:

- Functioning Partnership joint undertaking (championed and owned by the universities and partly financed by the MO through ROP).
• Networking activities supporting cooperation between the supply-side and the demand-side, especially the speed dating with subsequent program for long-term partnership with participating businesses.
• Accessible and user-friendly Database of R&D equipment.

**Speed dating/business breakfast**

• Organization of several speed dating/business breakfast events with follow-up activities (and repeating events along themes with the biggest potential) leading to:
  o Understanding better needs of businesses and challenges they face and vice versa.
  o Exchange of information about demand and supply possibilities between companies and HEI.
  o Community (and trust) building in relevant domains, which create local buzz and global pipelines.
  o New leads/opportunities for technology transfer/commercialization.

**Joint database of R&D equipment and expertise**

• Existing database of equipment and expertise (possibly without specific software during the pilot, but ready to be implemented in future) leading to:
  o Rising number of services provided by local HEI to industry.
  o Higher recognition of demand and needs of companies by researchers.
  o Higher intensity of cooperation between local enterprises and HEI.

**Pilot B (PoC support program) Outputs**

• Proof-of-concept program offering support to early stage technologies helping (i) those not successful in the nation-wide schemes and (ii) supporting projects with significant regional importance with lower TRL.
• List of promising technologies with sufficient TRL to attract companies from the region.
• At least 10 supported early stage projects.
• At least 3 successfully commercialized projects (licenses, start-ups, spin-offs) from either strand of the PoC program.

**Indicators**

**Pilot A (Partnership) Indicators**

**Partnership**

• Number of joint activities (joint event such as speed dating; joint “projects” – single-point-of-access database, IP evaluation board, joint marketing tool, etc.)
• Number of successful (new) university-business collaborations; at least 4 new collaborations are expected

**Speed dating/business breakfast**

The following KPIs could be used to measure the effectiveness and efficiency of such events:
• Quantitative
  o Number of new collaborations (contractual research, joint project, license, etc.)
    between participants; at least 4 new collaborations (contracts) expected
  o Number of researchers and companies participated at the events; at least 20
    participants on average at each event, 50% from business
  o Number of organized speed dating/business breakfasts events; expected at least 8
    events
  o Number of PhD/young scientists as a participants; at least 20% of academic
    participants
  o Number of newly gained relevant contacts; at least 20 new leads created
• Qualitative (separately for HEI and business, collected through surveys):
  o Share of participants seeing the speed dating useful in their work
  o Share of participants taking part in more than one event (returning participants)

**Joint database of R&D equipment and expertise**

The following KPIs could be used to measure the effectiveness and efficiency of such IT solution:

• Number of services provided by local HEI to industry through the IT solution; at least 5 new
  contracts expected
• Number of laboratories participating in services for industry
• Change of the machine time of the equipment used for industry activities; at least 15% increase

**Pilot B (PoC support program) Indicators**

The following KPIs could be used to measure the effectiveness and efficiency of such a program once
implemented:

• Number of eligible PoC projects supported; at least 10 eligible PoC projects
• Number of companies declaring interest in the technologies supported from the program; at
  least 1 company declaring interest in a technology in the PoC scheme
• Number of successfully commercialized PoC technologies/products/start-ups; at least 3
  technology successfully commercialized (minimum 30% success rate).

**Timeline**

**Pilot A (Partnership) Timeline**

Setting up/implementing the pilot could take between 3 and 6 months. Such a program should then
be monitored for at least 2 years to gauge impact. Yet, indicators can be assessed after the first year
(12 months) and continuation of the action decided upon.

**Partnership**

• 3 months to prepare and implement
• 6-12 months to pilot the activities

**Speed dating/business breakfast**
Setting up/implementing the pilot could take between 2 or 3 months. Each speed dating/business breakfast event should be continuously monitored through follow-up activities and through surveys after the end of the event and after 6 and 12 months after the event. Indicators can be assessed after the first year (12 months) and continuation of the action decided upon.

- Surveys after the end of each event to measure satisfaction of participants and outcomes of the event followed by a survey after 6 and 12 months.
- Follow-up activities organized by HEI (led by BUT) and measuring the success of the “sales process” (e.g. new contracts or projects from companies). Start the follow-up activities two weeks after the end of the event.

**Joint database of R&D equipment and expertise**

- 3 months to gather data
- 3-6 months to implement a basic digital platform if relevant within the pilot
- First use of the equipment using the database in months 6-12

**Pilot B (PoC support program) Timeline**

Setting up/implementing the pilot could take between 3 and 6 months. Such a program should then be monitored for at least 2 years to gauge impact. Yet, indicators can be assessed after the first year (12 months) and continuation of the action decided upon.

- 3 months to prepare the rules and documentation
- 3 months to implement (call for projects)
- The program open in months 6-12
Objectives of the pilot

The main objective of the pilot in Dolnoslaskie is to investigate the feasibility of establishing and sustaining ‘business led challenges’ (BLC) that can be met by teams of researchers and students from the universities and organized and coordinated by a consortium, preferably led by the Lower Silesia Agency for Development (DARR) and a university and with the involvement of other key stakeholder groups such as the Marshall Office of Lower Silesia the Lower Silesia Employers Association, and Wałbrzych City Council. In the longer term, a successful short BLC could be converted into a longer internship at a company for a team or an individual.

The primary purpose of such a BLC will be to help enterprises to solve development problems and in particular the implementation of innovative solutions.

The main goal will be increasing the interest of enterprises from the Wałbrzych sub-region to conduct research and development activities and implementing innovative solutions using knowledge from the scientific community.

The pilot will lay the ground for more Problem Based Learning (PBL) methods of education in line with the EU Education and Training Strategy ET2020 and for the development of Knowledge Transfer Partnerships (KTPs) between enterprises and a knowledge provider, implemented through a graduate. It will also serve to establish and strengthen linkages between the HEI and the enterprise base, build mutual trust, improve the understanding of the HEI of the needs of enterprises and improve the innovativeness of the enterprises themselves.

The pilot will also contribute to the ongoing Smart Specialization ‘process of entrepreneurial discovery’ in the region by providing a feedback loop between innovative enterprises, the R&D Sector and the Marshall Office.

Rationale (background and justification for the proposed approach)

The Lower Silesia region as a whole is one of the better developed in Poland and hardly fits the definition of “Lagging” or “Catching up”. Nevertheless, its sub-region, centered in the city of Wałbrzych, fares substantially below average, in particular with regard to the capacity of the research ecosystem and the innovation culture and activities of established SMEs. The sub-region has only one academic institution, a regional division of the Wrocław University of Science and Technology (WTU). The division does not conduct any research and development activity by itself (those are conducted in Wrocław), focusing its mission on teaching only. As a result, local businesses do not have local research counterpart to engage with on long term projects and the lack of proximity to Wrocław (70 Km) is cited as a major barrier to conventional innovation support interventions e.g. use of an innovation voucher. Local, established SMEs are also rather traditional in their approach, not having an internal culture that makes them eager to seek out innovation either in business practices or in new products and services. This also means that the level of innovation support they are currently seeking does not always fit well

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89 https://ec.europa.eu/education/policies/european-policy-cooperation/et2020-framework_en
to a strong research university unless it can be aimed at undergraduate or Masters level students and integrated in to the teaching mission.

Nevertheless, local businesses do benefit from accessing local technical talent among the regions’ graduates and mentoring schemes are popular amongst both undergraduate students and local businesses who use them as a recruitment tool. However, retention of good talent can also be challenging due to the higher wages available in Wrocław; this further impacts realization of innovation potential of local SMEs. A mechanism is needed to bridge the geographical and innovation ‘gap’ between the R&D base in Wrocław and the businesses in Wałbrzych.

Business led challenges are increasingly common for student teams as an extra curricula activity. They also increasingly form part of Active Learning and in particular Problem Based Learning where their benefits are more fully recognized by HEIs through the ECTS system. They work well in locations where there is a lack of strong public research or high-tech cooperation between academia and enterprise but a source of good education and thus young ‘talent’. Students learn problem solving and team working skills that enhance their employability. Companies have the opportunity to move forward with projects that are held by internal resource constraints and may ultimately obtain a ‘solution’ from the activity and a new employee. HEIs build modern and attractive educational programs. Most importantly, this type of activity sets up a knowledge transfer triangle between the HEI, the enterprise and the student(s); this is often then translated in to a more direct cooperation between HEI and company and can ultimately lead to the HEI becoming the strategic R&D partner for an enterprise.

Schemes to support such knowledge transfer through a paid studentship are now increasingly common in the EU and include the UK Knowledge Transfer Partnerships90, the German Innovation Assistants91. Combining a ‘Challenge’ with an internship is also a key aspect of the ‘SSP Co-Fit’ scheme in the Czech Republic92. In SSP Co-Fit the university is fully informed and involved and can assess the outcome of the internship. In SSP Co-Fit and at other Universities e.g. the University of Tartu in Estonia who run iAcadamy, the students can in some situations generate and own IP from the internships which can be used as the basis to form a ‘start-up’ company.

Both Wrocław Science and of Technology and the University of Economics are already involved in popular student/ business mentoring programs and also business internships programs e.g. Forge. In addition, the Wrocław University of Technology is in the process of trying to establish a student/ masters level Business Challenge, based on a model they have been observing at Stanford USA. This will be under the POWER Program (Operational Project Knowledge Education Development) and will be funded at national level. While the initial idea was for an extra-curricular activity the Pro Rector for Science is also interested in finding a way to award ECTS points for the activity to encourage more students to become involved. POWER will need to identify strong challenges and will be seeking funds to cover student mobility so they can spend time with companies (providing proximity and bridging the present geographical ‘gap’) as well as some funding for academic and business mentors. Use of student teams and young researchers will also enable ‘entry level’ innovation challenges to be addressed, alongside the more demanding ones that are tackled by senior research teams at the

90 See http://ktp.innovateuk.org/
91 See https://www.ibb.de/en/fundingprograms/innovation-assistant.html
92 See https://ssp.fit.cvut.cz/
University. There is therefore a potentially good fit to a pilot Challenge program to tackle the identified problem in Wałbrzych.

The alternative to trying to tackle the lack of innovation culture in established SMEs in the region would be to try and encourage more new start-up companies who would be born with a cultural that embraces innovation. The source of such companies might be local high school students and/or the Vocational Training Schools and the seed for the company might come from large businesses who are able to identify a challenge which, if solved, would be of sufficient substance to nurture a new company. This works when the larger company, e.g. Nokia or Toyota (both who have a presence in Wałbrzych) do not wish to retain ownership of the IP associated with the ‘solution’. Large businesses are sometimes willing to take part in such schemes as part of their Corporate Social Responsibility (CSR) activities. This model has already seen some success in the Wałbrzych region through the ‘Futurepreneurs’ program and is an established model in other countries e.g. on the HEI led STARTER program at Tartu University\textsuperscript{93}, financed by the EU Social Fund where students own the results of the challenges and are encouraged to start their own businesses to bring them to market. However, such projects are frequently ICT focused and do not require specialized skills or equipment and ‘solutions’ are most normally for use inside an enterprise e.g. enhanced business processes, because strong technology and protectable IP is difficult to generate by young student teams working in a ‘public’ environment. The main benefit for a company from such a program is usually in identifying ‘talent’, in a low cost and low risk way, with a view to more permanent recruitment or in making their involvement part of a CSR action.

The strong presence of IT enabled solutions has often led to such activities being termed ‘Hackathons’ but they can, and do, develop non-ICT enabled solutions. A good example is the CityOS Challenge Mostar\textsuperscript{94}. This activity, led by the City of Mostar, involves a 3-day ‘Hackathon’ followed by a 3-month city-sponsored internship for the finalists. The internship allows a company to innovate in a more private space in a way that would enable patenting and it enables the enterprise to make a stronger assessment of the students with the view to long term recruitment.

However, this is a long term solution to developing innovative SMEs for a region and requires a strong investment in to the start-up program e.g. mentoring, incubation, acceleration and facilities for prototyping. Such a youth entrepreneurship program might benefit from building on an established successful Challenge e.g. one for undergraduate and Masters students and where an HEI is already strongly involved.

The region’s situation is reflected in the SWOT below
### SWOT of Dolnośląskie sub-region innovation ecosystem

**STRENGTHS**
- Lower than average unemployment and positive employment trends.
- Demand side: Automotive sector (and sectors related to the automotive field through value chains), transportation and chemicals sectors.
- Supply side: Pharmaceuticals and biotechnology.
- Patenting in the field of civil engineering.
- Presence of some organizational units of universities and Institutes from Wroclaw and beyond.
- Dolnoslaski Park Technologiczny (T-park;)
- Pool of good undergraduate students.
- Active employment agency (DARR).
- “Futurepreneurs” program supporting start-up creation.
- Engaged and committed City (Mayor).

**WEAKNESSES**
- Lower than average wages and salaries
- Low local firm level innovation and TT.
- Low interest of the Wałbrzych enterprises in innovating for competitiveness.
- Poor match between supply and demand side strengths reducing the potential for technology transfer.
- HEI activity does not generate R&D that can be transferred/commercialized (focus on teaching).
- Traditional education programs.
- Disparity between levels of supply side skills/technology and demand side needs.
- Low level of cooperation between the supply-side and the demand-side.
- Low inclination in the HEIs for collaboration with enterprises on basic innovation actions.
- Low attractiveness of the sub-region to talented graduates compared to other parts of the Lower Silesia Voivodship.

**OPPORTUNITIES**
- Strengthening the R&D link between enterprises and Wrocław University of Science and Technology in Wroclaw with a focus in the broad field of chemistry.
- Spinout activity in areas of unmatched supply side strengths.
- Startup activity focused on good high schools and the Futurepreneurs model (CSR driving larger companies to propose challenges where they do not want to own the IPR).
- Increased/expanded use of innovation voucher scheme.
- VC fund focusing on clean-tech and smart city.
- Shift of traditional teaching towards PBL and a CDU, driven by the recent reform of the Polish system of higher education and ET2020.
- Possible ‘Protolab’ space in the Old Mine (Stara Kopalnia).
- Building a KTP program based on an industry led challenge + and internships and funded by the ROP.

**THREATS**
- Lack of buy-in to new initiatives (both supply and demand side).
- Restructuring of the HEI sector.
- Lack of match between skills of students and enterprise innovation needs.
- Low level of trust in enterprises for collaborating with HEIs.
Business Led Challenge and Problem Based Learning pilot
Proposed activities and associated outputs

The proposed pilot will be divided into two main Phases.

In Phase 1 a group of 30 MSMES (Micro Small and Medium Enterprises) will be selected from among the larger group of entrepreneurs interested in cooperation with the scientific unit and granted the following support:

- A company audit, within which the problem to be addressed will be identified and one or more possible solutions proposed. This stage will be run by experienced researchers.

Due to the fact that the barriers in cooperation between entrepreneurs from the Wałbrzych Agglomeration and scientific units include the physical distance to the specialized R&D units located in Wrocław, the uncertainty of entrepreneurs as to whether they are an appropriate partner for an R&D collaboration and whether their problems are appropriate to be solved by university scientific units and student and a lack of resources (time/staff/etc.) in the enterprises to enable them to overcome the physical distance and search out the right specialized partner from Wrocław, it is proposed that the matching of entrepreneurs with scientific units will take place by organizing meetings of entrepreneurs with teams of scientists in the Wałbrzych Agglomeration. Suitable space for these consultations will be provided by partners in the action.

- Duration: M1 - M6 months.
- Output: a report indicating the proposed action plan and preferred intervention method e.g. direct advisory or Hackathon.

In Phase 2 15 SMEs will receive individual innovation support while the remaining 15 will participate in a Hackathon to implement their proposed Phase 1 action plan.

Innovation Support

- This stage will be run by advisory teams, individually dedicated to each enterprise, delivered by mentors (experienced researchers), and students (predominantly undergraduates and Masters level students with the option to involve PhD students if this is appropriate and feasible. Duration: M7 - M18 months.

- Output: a report indicating the solution to the problem implemented e.g. a prototype tested or a feasibility study concluded.

Hackathon

- 15 SMEs will participate in Hackatons. There will be 5 Hackatons, each one involving 3 companies and challenges. The mentor will be responsible for organizing the right team to solve the problem. Duration: M7 - M18 months.

- Output: a short non-confidential report indicating the outcome of the Hackathon.

Key Stakeholders in the action
Following recent discussions with the MO and other key stakeholders the WB team recommends a pilot BLC based on:

- The willingness of the MO to consider adapting their ROP to enable a pilot to take place and to participate as a member of the consortium;
- The emergence of a clear champion for the pilot in the form of the RDA Dolnośląska Agencja Rozwoju Regionalnego S.A. who is willing to invest time and resources in its success;
- A commitment from the Wrocław University of Science and Technology to deliver the innovation support; and who has access to the doctoral and post-doc researchers needed to act as “R&D mentors” and student teams as well as the necessary R&D facilities;
- Other key local stakeholders who are fully committed to the success of the project and who can recruit local companies to the challenge and help deal with the administrative side of the pilot (PR, providing contacts with businesses, oversight over common spaces etc. include the Lower Silesia Employers’ Association, Wałbrzych T-Park and Wałbrzych City. These stakeholders will also be part of the proposed consortium.

Target groups

The main target groups for the intervention are:

- Local businesses who can help define the challenges and offer business mentoring support;
- Undergraduate students and Masters level students, including Wałbrzych area students studying locally and elsewhere;
- More senior researchers from WUT who will carry out the Phase 1 assessment and mentor the more junior teams in Phase 2 R&D activities;

Pilot Evaluation

While conducting the pilot, a roadmap for embedding such business led challenges + KTP into one of the major stakeholders e.g. the University or the City should be created. Issues to be investigated include, among others:

- The level of challenges that can be tackled by student teams and the value of the solutions to business;
- The willingness of business to publicly share real business challenges;
- Levels of interest from students in participating in such extra curricula or accredited activities alongside their studies;
- Levels of interest from senior researchers in mentoring the student teams alongside their own teaching and research commitments;
- The benefit of having an online portal to collect challenges and match them to students;
- Interest and willingness of local enterprises to follow a challenge with a KT partnership;
- Issues of having students work inside the enterprise e.g. employment law, insurance, supervision, and IP;
- Interest of the HEI to supervise students working for a longer period (2-3 months) on such a KT project within an enterprise;
- Duration of the activities needed for a meaningful outcome (challenge + internship);
• Additional benefits e.g. increased employability of graduates in the region, highly qualified graduate retention, improved competitiveness of enterprises, strengthened HEI and enterprise relationships.

• The role of the City of Wałbrzych and MO authorities, e.g., in co-financing some aspect of the future program for a defined period (no shorter than 5 years) and possibly providing a common space for experimentation and prototypes development;

**Long term planning**

In the longer term it is suggested that the Local MO and Mayors office should investigate the feasibility and benefit of setting up a longer term KTP program, aimed at local enterprises and funded by the ROP. The MO could explore commonalities and differences with other programs that combine both a ‘Challenge’ and a student ‘internship’ e.g. the Czech Republic SSP Co-Fit model and the option to generate startups from student owned IP as in the example of iAcademy Tartu. Aspects to be investigated based on a successful pilot could include:

- the merits of introducing an online Portal to collect challenges (local and from beyond the immediate region) and to match them to local students.

- the benefits of creating a common physical space, equipped with basic hardware and software tools and equipment to allow the student teams to design and create prototypes of products; the Mayor of the City of Wałbrzych has expressed interest in finding such space or adopting the existing one in the Old Mine (Stara Kopalnia) building.

- the interest and commitment of both the HEI and the company to supervise and mentor a number of KTPs over a longer period of time e.g. 2-3 months.

- Securing stronger funding to enable the most successful or interesting challenges to be converted in to KT partnerships either for a full team or an individual student. The alternative will be for the costs to be fully covered by the enterprise but some form of ‘triple helix’ mechanism may encourage early up-take.

- The possibility to graduate startup from the Hackathon program.

**Instrument and Financing structure**

The financing of the TA during the initial design stage is covered by the existing WB project financed by the European Commission (June 2019).

Funding for the pilot is expected to be made available through a modified ROP. The funding will (i) help further develop the design and set up of the pilot and (ii) cover the administrative costs of the pilot and its promotional activities.

The action would be designed to sit under the OP Priority: Business Advisory.

Given the regional uniqueness of the partners needed to implement this pilot it is suggested that the best approach would be to structure the action so that a grant could be made available to an eligible consortium e.g. one led by the Dolnośląska Agencja Rozwoju Regionalnego S.A. and including other essential stakeholder groups such as an R&D intensive HEI (Politechnika Wrocławska) and the Employers Association etc.
The alternative of a competitive structured call would not result in a number of strong consortia of the correct composition to successfully deliver the pilot.

This structure would offer some advantages over direct financing to an enterprise:

➢ It would be possible to award a grant up-front to the consortium members, including the HEI and not have to reimburse costs to an enterprise after they have been incurred. The enterprise therefore would not have to find a way to cover the costs e.g. through a bank loan;
➢ Research teams would issues de minimums certificate so no cash flow and no collateral was needed from the SME;
➢ The consortium would manage the project and collect 15-30 ‘challenges’ and match these to teams who would solve each problem for a fixed rate;

Some level of ‘in-kind’ funding from the enterprises would be expected e.g. to help mentor the student teams or the interns.

Tasks and responsibilities

The following tasks and responsibilities are envisaged:

1. Urząd Marszałkowski Województwa Dolnośląskiego (MO) consortium partner tasks:
   - coordinate the pilot and its effects through the programming of new instruments to support innovation in ROP 2021-2027.
   - Contribute to the project budget
   - Dissemination of the initiative through the publication of press articles / inserts (writing of texts and publication in the regional and local press), and then sharing of the results in the form of a publication presenting the project as a good practice in the context of ‘industry led challenge’ and ‘problem based learning’ to support the underlying and ongoing S3 concept of the entrepreneurial process of discovery and cooperation between business and science as well as organization of a conference at the end of the project
   - other, indicated at the stage of preparing the project fiche

2. Dolnośląska Agencja Rozwoju Regionalnego S.A.(DAAR) - Consortium leader tasks:
   - preparation of the project fiche for the ROP WD 2014-2020
   - coordination the project in accordance with the principles set out in the ROP WD 2014-2020 project settlement with the managing / implementing institution of the ROP WD 2014-2020
   - project settlement with the ROP’s 2014-2020 Implementation Institution
   - project settlement with the partnership / consortium members
   - recruiting enterprises to participate in the project
   - selecting enterprises with an innovation ‘challenge’ to be addressed
   - Dispersing ‘scholarships’ to students involved in the advisory where appropriate and possible
   - evaluation of the project progress and gathering date to support the entrepreneurial process of discovery
   - providing a space for meetings between enterprises and the innovation service providers
   - other, indicated at the stage of preparation of the project fiche
3. Politechnika Wrocławska (WUT) - consortium partner

tasks

- Implementation of support services for entrepreneurs based on teams of researchers and students. This task will be divided into two parts:
  o Task 1 – enterprise audits – to identify and diagnose a problem/challenge that can be addressed by an external team; implementers: experts (researchers and staff of the university). Duration: M1 - M6;
  o Task 2 - Innovation services for enterprises (Advisory and Hackathons)
    o Advisory: introduction of innovation directly to the enterprises over a period of weeks/months: Implementers: Mentors (senior researchers and staff of the university), and young researchers (undergraduate and Masters an students)
    o Teams: 15 teams of 4 people per team.
    o Hackathon: Short focused problem solving, primarily using teams of undergraduate students, supervised by a university Mentor.
    o 5 Hackathons will take place with 3 enterprise challenges per Hackathon
    o Teams: 15 teams of 4 people per team.
    o Duration: M7 - M18.
- other, indicated at the stage of preparing the project fiche

4. Gmina Wałbrzych ( WALBRZCYH City) consortium partner

tasks:

- promotion, including the following no cost actions:
  o covering the project with the patronage of the Mayor of Wałbrzych;
  o sending e-mailing to the media (preparing an e-mail by the Leader or DP);
  o organizing press conferences at the City Hall including using the meeting room; news on Facebook and the Wałbrzych Commune website;
  o placement of citylight posters (development of posters on the side of the Dolnośląsacy Pracodawcy);
- provision of a space to be used for Hackathons or meetings with the innovation advisory teams and the enterprises.
- other, indicated at the stage of preparing the project fiche

5. Dolnośląsacy Pracodawcy (Lower Silesian Employers Association) consortium partner

tasks:

- Promotion, including:
  o Development of a visual identity and associated elements (including purchase of photos, graphic creation)
  o Web Landing page + hosting
  o Announcements regarding recruitment and project implementation in local portals and in traditional press
  o Radio broadcasting
  o Social media
  o paid campaigns in social media, AdWords Google
  o Design of information brochure about the project (A4 format, color, two-sided)
  o Designing poster for citylight
  o Printing (500 pieces)
- Purchase of information roll-ups for recruitment purposes (5 units) - for all partners
- Recruitment meetings (2) - room, catering, invitations (4 meetings x 30 people)
- Preparation of materials and gadgets for recruitment meetings
  - other, indicated at the stage of preparing the project fiche

Other issues to be addressed

Ownership of IP and exploitation rights

Ownership of results and specifically any IP rights will be determined individually with each enterprise on a case by case basis. The University will take a strong lead on this issue. Under the innovation support it may be best for the enterprise to fully own the results of the intervention so that they can continue to use it internally as a process or in a new product/service. Under the Hackathon there may be scope for the student teams to own the results and to consider setting up their own company to exploit them further. Good Practice from other similar activities will be considered.

In all cases the situation will be formalized before the Phase 2 activity commences.

Involvement of students

It is essential to develop a formula that will encourage students to participate in the project. Students involved in Phase 2 advisory services may be eligible for some type of financial ‘scholarship’ alongside having all their expenses covered by the project. This would encourage them to engage in an activity that may be quite time consuming and take place over an extended period. Undergraduate students who are involved in Hackathons are less likely to be eligible for such support but as the time commitment is lower they may be interested to participate for the experience alone. Involvement in both types of Phase 2 activities will contribute to student learning and this may be an inducement to participate, as PBL and other forms of Active Learning are increasingly seen as a asset to a CV and to employability and career development. However, in both cases it would be very helpful if the university can find a way to recognize the time commitment using the ECTS system.
## Risks and mitigation

<table>
<thead>
<tr>
<th>Risk</th>
<th>Likelihood (L/M/H)</th>
<th>Impact (L/M/H)</th>
<th>Mitigation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low demand for such an activity from Wałbrzych enterprises and an unwillingness to commit time and monetary resources.</td>
<td>M</td>
<td>H</td>
<td>Strong promotion and liaison with local stakeholders to design the program sell the benefits and secure early commitment.</td>
</tr>
<tr>
<td>WUT is unable to commit resources (researchers to help mentor the student teams and possibly prototyping design and development space).</td>
<td>L</td>
<td>M</td>
<td>Link to the forthcoming University Challenge. Award of possible ECTS points. Award of some financial ‘scholarships’ to students to recognize their time commitment.</td>
</tr>
<tr>
<td>Students are not interested in participating.</td>
<td>L</td>
<td>H</td>
<td>Raised awareness in the HEIs of the changes taking place in their approach to using active learning so the HEI will want to embed the activity in their teaching.</td>
</tr>
<tr>
<td>MO and the City will not wish to provide financial support to enable to activity to be rolled out regularly.</td>
<td></td>
<td></td>
<td>Retention of a strong role for the MO or the Council (i.e. as has happened for CityOS Challenge Mostar) so it can remain an extra-curricular activity and a pivot towards generating startups and youth entrepreneurship.</td>
</tr>
<tr>
<td>PBL does not become embedded in to a HEI undergraduate teaching curriculum e.g. as part of a Problem Based Learning approach to education</td>
<td>M</td>
<td>M</td>
<td>ENSURING THAT THE VALUE FOR COMPANIES IS HIGH SO THAT THEY SEE THE PROGRAM AS AN INGOING RESOURCE.</td>
</tr>
<tr>
<td>Lack of new challenging but feasible problems from the local businesses and wider community.</td>
<td>L</td>
<td>H</td>
<td>ENSURING THAT THE VALUE FOR COMPANIES IS HIGH SO THAT THEY SEE THE PROGRAM AS AN INGOING RESOURCE.</td>
</tr>
</tbody>
</table>

## Main counterpart

The Marshal Office and the City of Wałbrzych will be the starting-point for the pilot through the revision of the Operating Program. The Dolnośląska Agencja Rozwoju Regionalnego S.A. will support the revision of the OP.

Once the OP has been revised then the main counterpart will be the implementing consortium, most probably led by the Dolnośląska Agencja Rozwoju Regionalnego S.A.
Outputs

The following main outputs are anticipated from the pilot:

- Enterprises accessing talented and technically strong students (talent recruitment)
- Student developed solutions at the prototype or higher TRL
- Student developed solutions transferred and adopted by enterprises

Indicators

The following KPIs could be used to measure the effectiveness and efficiency of such a program once it was implemented:

- Number of challenges defined by businesses
- Number of student teams established
- Number of PRO based mentors
- Number of business based mentors
- Number of ‘solutions’ transferred to business
- Number of students recruited to a position in the company
- Number of enterprises returning to the program (for the further editions)

Timeline

It is estimated that setting up/implementing the pilot would take between 6/18 months. Results should be visible after 12 months. Impact should be monitored over a longer period e.g. 2-3 years.

Budget

The budget of the initiative will be around about PLN 2 500 653,75.

The participation of enterprises in the initiative will be 100% covered by the initiative and will constitute de minimis aid for them.

The Lower Silesia Authority and the Walbrzych commune will provide its own contribution to the project at the total level of 5%.

A detailed budget was prepared by the Team in close cooperation with regional stakeholders and will be available as a part of documentation for the pilot program of Dolnoslasie ROP.

Beneficiaries:

Micro, small and medium entrepreneurs (MSME) currently operating in the area of the Walbrzych Agglomeration, with preference for those whose activities are part of the Lower Silesian Smart Specializations.
Objectives of the suggested pilots

The main objective of the pilot in Łódzkie region will be to:

a) address low demand side engagement in innovation activities by improving existing enterprise support instruments,

b) realize supply side potential by increasing capacity to commercialize research.

Background

Two capacity building pilots have been designed and prepared for launch in the Łódzkie region. The development of the pilots occurred through a series of consultation sessions with the region’s stakeholders (mostly the MO and the universities, but also representatives of the local business community and the City of Łódź).

The so-called Pilot A, devoted to the uptake of the ROP by region’s enterprises centers primarily on fine tuning the mission and upgrading the capabilities of the MO’s Centers for Business Innovation (“CBI”) unit. The goal of the design process was to discuss ways to more effectively use CBI structure and people to increase the demand for innovation-targeted ROP funds on the part of Łódzkie region entrepreneurs. As was stated in the Steering Committee meeting, the high-level objective of Pilot A is to put “I” (or “Innovation”) back in CBI activities.

Detailed design of the so-called Pilot B (see below for the design details of the I-corps – type initiative) has been accomplished through a series of meetings in the region with the MO and university representatives. One meeting involved the heads of the three university CTTs (Centers for Technology Transfer). The second meeting included the MO Director Małgorzata Zakrzewska and her reports. The WB team also participated in the “Young in Łódź” program, meeting some potential candidates for the trainers in the contemplated program (entrepreneurs in the Łódź ecosystem). As was stated in the Steering Committee meeting, the high-level objective of Pilot B is to build commercialization capabilities among Łódź area research teams, in particular with regard to commercialization via the start-up route. Since such a capability-building program has been missing so far in Poland, it is assumed that Łódź could serve as a benchmark for other Polish regions. In addition, trainers trained during the program in Łódź could then serve to roll-out the program to other locations.

Pilot description

Pilot A: Increasing uptake of the ROP by enterprises

Areas of focus

The pilot addresses the root causes of the current situation, which is characterized by a low uptake of the ROP by the region’s enterprises. First, the WB team identified some potential ways to make the regional program distinct from and in some ways more attractive for the local entrepreneurs than the national-level programs (such as programs managed by the National Centre for Research and Development). Secondly, through capacity building at the MO level, the pilot focused on enhancing the effectiveness of educational efforts among the local businesses of the ROP. In particular, pilot A
focuses on the use of existing mechanisms (such as MO’s Centres for Business Innovation, or CBI) to encourage local firms to partner with the Łódź-region PROs on promising commercialization projects. As a result, Pilot A focuses mainly on:

- Designing a capability-building program for CBI personnel (and possibly Centre of Services for Entrepreneurs) on how to stimulate demand for good R&D projects among the region’s entrepreneurial SMEs
- Providing recommendation on systemic changes to the CBI set up to enhance the effectiveness of the program (e.g., new role descriptions, KPIs, databases of information, marketing materials, etc.)

Status quo of the Centre for Business Innovation (CBI): considerations for Pilot A design

CBI, a unit of the MO liaising very closely with local businesses, appears to have the potential to be perfectly positioned to carry out the mission of increasing the uptake of the ROP. However, field interviews with members of this unit showed that insufficient focus is put on stimulating innovation by CBI personnel, which can be traced to the fact that the CBI project (itself financed from the ROP) was in fact launched as part of the larger regional program for promotion of exports. As a result, the measure of success of CBI personnel performance is reflected in the number and amount of export contracts signed by the enterprises they support. The compensation of CBI employees is in any case flat, and does not have a performance-based component.

Of the several CBI personnel, only two are 100% dedicated to the job. The remaining people are employed by the MO part-time (they are expected to spend 50% of their time on CBI activities). The current term of their employment is about to expire on March 31st, 2019. There is a new recruitment effort underway at the MO for the extension of the program (which has been secured for the period of at least half a year). It is expected that a significant part of the present CBI personnel either has re-applied or will do so.

The implication of the above for the potential to fine tune the current design of the CBI project is that it is impractical to do so. The project in its original form cannot be altered, and besides doing so is neither feasible nor sensible in a situation when it is coming to a close. However, given the likelihood that the CBI project is further extended beyond the 6-month period already approved, this could offer an opportunity to redesign the project and identify a new funding mechanism for it.

Detailed Pilot A design

As a result of the aforementioned considerations, Pilot A includes three groups of activities:

1. Capability-building among the CBI personnel (but also selected personnel of regional CTTs):
   a. Workshop(s) for the CBI and CTT personnel
   - The workshop should focus on defining and building critical skills needed to work with innovative entrepreneurs and translate their goals and aspirations into the language of new R&D projects and technological challenges to be addressed. Case study method will be used. Examples of re-defining means (“I want to buy a warehouse automation system”) as objectives (“I need to

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95 Most likely one workshop should be sufficient, although if needed more could be considered.
increase the productivity within my warehouses”) will be dealt with. Attention would be paid to identifying the need to partner with top academic institutions, as well as do’s and don’ts of such collaboration.

b. Pilot visit(s)\textsuperscript{96} or session(s) with local innovative entrepreneurs (to illustrate the approach to encourage them to consider ROP funding)

- The objectives are similar to the ones set for the workshops described above. The difference is that these would be accomplished in “live” sessions with sample entrepreneurs in the room (a choice needs to be made whether this would be a combination of 2-3 visits to individual companies, or a session with a few companies present).

2. Preparation of collateral and information to assist CBI personnel in their work:

a. Preparation of the database of most likely łódzkie region innovators (“the target group” for CBI)

- Based on the WB team interviews, such database is likely to comprise at least 100+ companies from the Łódź region. The database should include the basis data about the companies, as well as a list of potential technology issues/challenges they face (those could be met by potential R&D projects to be co-financed from the ROP). The assumption is that the data in the database would be provided by the CBI personnel with guidance from the WB team.

b. Design and preparation of materials explaining the program to businesses in a simplified, “marketing” manner:

- These seem necessary given the perceived complexity of the ROP application materials and the unclear Value Proposition for the entrepreneurs. The WB team could provide a format for those materials.

3. Preparation for the changes to the ROP to identify a new funding model for CBI (including funding in the new EU perspective)

- A set of succinct recommendations (in the form of a “fiche”) for the EU Commission should be developed in order to tee off the modified CBI project to be funded in the new perspective. This should cover, inter alia, objectives, KPIs, proposed motivation system, a reporting system of the project, potential partners/collaborators (e.g., CTTs), etc.

- In particular the issue of the motivation system should be given careful consideration in the future design of the project. Since CBI personnel is employed by the MO, there are limitations to how far this system could be made performance-based (which would be desirable). Still, design should attempt to consider such mechanisms as bonuses, raises, extra remuneration for skill-building, etc. in order to better align the objectives of the modified program with CBI personnel’s performance.

\textsuperscript{96} As with workshops, one such visit/session may suffice
Pilot B: Building capacity in the wider public R&D base to help bring more commercialization knowledge to market

Pilot B design considerations

Pilot B aims to design and execute joint training for the researchers and the TTOs to help them recognize R&D based opportunities and bring them closer to the market. The pilot would be used to recruit and help train national trainers for the future with the objective to establish a ‘TtT’ (“Train the Trainer”) approach. The initiative would be focused initially on the Łódzkie region and researchers and TTOs from the local PROs, but would have the longer term objective of offering the training program more widely and perhaps making it a national level program, aligned with other initiatives such as the Poland500 and Incubator+ programs. The pilot would be based on good practice from the EU and aligned with the EU strategy for Education and Training ET2020\(^7\) and further afield e.g. the US NSF iCorps program\(^8\).

As stated above, Pilot B design process involved a series of consultative meetings. The meetings were positioned as brainstorming sessions, where the goal of the WB team was to learn the perspective of the local stakeholders on key design issues. The meetings framed some of the key issues to be addressed:

- Goals and structure of the program
- Expected level of interest in and support for the program from the CTTs, universities and researchers
- The importance of the I-corps “brand”
- The trainers
- Recruiting research teams
- Governance of the program (beneficiaries, flow of money, etc.)
- Financing the program

Goals and structure of the Program

I-corps programs aim at increasing the rate of successful university-originated start-ups by building necessary commercial skills for those researchers willing to try their hand in business. As mentioned above, the extra objective would be to train a cadre of trainers who would be capable of conducting successive rounds of training with both Łódź and other Polish targets.

A typical I-corps capability building program can be delivered in two ways: an eight-week, full-scale program, and an abbreviated three-week program. The region’s stakeholders (e.g., CTT heads) feel strongly that a longer version of the program would face a much lower demand from researchers (not to mention a much less enthusiastic reception from university rectors). As a result, it appears that the three-week version has much greater chance of succeeding. One particular implementation idea is to hold the sessions during the summer, when teaching duties are much lighter and the research teams can give the intense course their full attention.

\(^7\) See [https://ec.europa.eu/education/policies/european-policy-cooperation/et2020-framework_en](https://ec.europa.eu/education/policies/european-policy-cooperation/et2020-framework_en)

The I-corps program targets small teams of researchers who are interested in commercializing projects that typically are at 2-4 TRL levels. The program builds skills and capabilities in the following areas (the list below reflects topical design of program’s sessions):

- Product-market fit, ecosystems, workflows
- Distribution channels
- Customer relationships
- Revenue models
- Key partners, resources, activities and costs

The delivery of the program is implemented through a series of interactive lectures, team presentations and intensive field customer discovery process

Recruitment of the research teams

The shared view of the region’s stakeholders is that at least 3 months are needed to recruit the research teams for the program. Preparation with the rectors will be needed (e.g., the rectors could make it easier for the researchers to participate by relieving them from some teaching duties for the duration of the program). An open application process has been suggested during the meeting. Prior to the competition, extensive publicity campaign at the universities is being envisioned.

The trainers

It appears that Łódź technology ecosystem has some candidates who could fulfill demanding requirements for the future trainers (the trainers would be trained during the first edition of the program). Examples could include local entrepreneurs (some of them are already involved as mentors or experts for start-ups as part of the “Young in Łódź” program). Other examples could include people from the emerging local VC firms. Finally, it would be possible to attract trainers from outside Łódź to the program.

Governance of the program

The key design issue is who will be the beneficiary of the program (i.e., who will be the party receiving potential ROP support). One option is that the universities form a consortium. This is considered by the CTT leaders to be cumbersome (some past consortia were hard to implement due to the universities’ desire to underline their independence and position99). Another option (preferred by the local CTTs) is to form another Special Purpose Company, or SPC (this is allowed under the current law on universities); this SPC would then be the applicant for the EU grant to help co-finance the program. All CTT leaders agree that they are able to obtain their rectors’ support for this option. The financing options for the program are described in Section 7.

The delivery of the program

The consultation with the local TTC stakeholders surfaced three basic options to structure the delivery of the program:

99 This option is not to be dismissed without further consideration, however. One could use existing bodies such as the Council of the Łódź HEIs as a vehicle to execute this option.
1. The “true”, NSF-branded I-corps program. Delivered by the NSF-sanctioned trainers, it would bestow course completion “certificates” on the teams.
2. A program delivered by the trainers used by the NSF, but carrying the NSF (and I-corps) brand.
3. A program loosely patterned after the I-corps training, delivered by other (mostly local) trainers

During the consultation process with the CTT leaders, a strong preference was expressed by them for Option 1 (NSF-branded program). In their view this option enhances the odds of receiving strong rector support, significant interest from research teams, and interest from good local candidates for future trainers. Even though this option is likely to be the most expensive of the three, the university stakeholders would like to push ahead with the idea of the program structured in the way that not only closely resembles the original benchmark, but also could carry the NSF/I-corps branding. Last but not least, having some “certification” attached to the program is likely to increase its attractiveness to potential stakeholders significantly.

The pilot will build on good practices from the US NSF I-Corps program\(^{100}\) (see box below) the EU and align with the EU strategy for Education and Training ET2020\(^{101}\).

### Box 1. NSF Innovation Corps (I-Corps™)

The National Science Foundation (NSF) I-Corps program prepares scientists and engineers to extend their focus beyond the university laboratory and accelerates the economic and societal benefits of NSF-funded, basic-research projects that are ready to move toward commercialization. Through I-Corps, NSF grantees learn to identify valuable product opportunities that can emerge from academic research, and gain skills in entrepreneurship through training in customer discovery and guidance from established entrepreneurs.

**THE NATIONAL INNOVATION NETWORK**

Components of the NSF I-Corps National Innovation Network work together to grow and sustain the national innovation ecosystem. Through NSF activities and collaboration with other government agencies, NSF helps foster innovation among faculty and students, promote regional coordination and linkages, and develop networks.

**I-CORPS TEAMS**

I-Corps Teams participate in the seven-week I-Corps curriculum. Each I-Corps Team learns what it will take to achieve a commercial impact with their innovation. The I-Corps curriculum enables Teams to systematically identify and address knowledge gaps to understand the most appropriate path forward for their technology concept. I-Corps Team awards support the team’s participation in the curriculum and their customer discovery work.

**I-CORPS SITES**

I-Corps Sites nurture and support multiple, local teams to transition their technology concepts into the marketplace. The Sites provide infrastructure, advice, resources, networking opportunities, training and modest funding to enable groups to transition their work into the marketplace or into becoming I-Corps Team applicants. Sites are single-institution efforts to support innovation locally.

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\(^{100}\) See https://www.nsf.gov/news/special_reports/i-corps/

\(^{101}\) See https://ec.europa.eu/education/policies/european-policy-cooperation/et2020-framework_en
NSF has partnered with VentureWell to foster the National Innovation Network. Members of the I-Corps network can find additional resources on the VentureWell website.

**I-CORPS NODES**

I-Corps Nodes support regional needs for innovation education, infrastructure and research. The I-Corps Nodes work cooperatively to build, utilize and sustain a national innovation ecosystem that further enhances the development of technologies, products and processes that benefit society. Nodes are single- or multi-institution efforts to support innovation regionally.

**WEBINARS**

NSF hosts monthly webinars about the Teams program and annual webinars about Nodes, Sites and supplements.

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**Rationale (justification for the selected approach)**

The preliminary diagnosis of the Łódzkie R&D ecosystem suggests that the starting point is a relatively more mature R&D ecosystem than that in the other CuR3 regions. In particular:

- The local CTTs appear to have greater resources.
  - For example, the Łódz Medical University (ŁMU) CTT employs 10 people, and the Łódz University (ŁU) – 4, supported also by 11 people at the Centre for External Relations).
- The CTTs are able to demonstrate a longer history of in commercializing their university’s IP tangible results.
  - For example, at Łódz University of Technology (ŁUT), 9 university spin-offs have been established, with 3 already active in commercial markets.
  - The universities also appear to place strong focus on licensing activity.
- Funding interesting R&D-intensive projects does not appear to be a major challenge.
  - Local ecosystem players view funding issues as secondary to building such competencies as the ability to commercialize and scale-up promising projects.
  - Some of the universities (e.g., ŁU) even have their own small funds capable of funding projects.
- Łódź and the region have a few popular initiatives designed to promote start-up formation e.g. “Young in Łódź”[103], which attracts both university-based start-ups and entrepreneurs from outside of the local universities and has an extensive database of external mentors, as well as other forms of entrepreneurship, e.g., Sky Hub.
- There is an active outreach initiative on the part of the MO to the local business community (Centra Innowacji Biznesowej, or Centres for Business Innovation [“CBI”]). This initiative, although a success on some fronts, has not resulted in meaningful increase in local businesses pursuing ambitious R&D projects (especially those done in partnership with local universities).

However, despite these encouraging signs, there are also some challenges in bringing more research to market:

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102 *Fundacja Uniwersytetu Łódzkiego*

103 *Młodzi w Łodzi* – the initiative of the universities and the Łódź City Hall
• The local demand side for R&D appears to be relatively weaker e.g., ŁTU’s program for industrial PhDs did not receive a strong demand from local business; even large local firms such as Atlas are described as ‘laggards’ in the adoption of new technology.
  o One measure of this phenomenon is that, despite the aforementioned outreach initiatives by the MO, the level of ROP funds utilization remains relatively low (thus making urgent the need for Pilot A – see below);
• As the Analytical Report identifies on the basis of company interviews, “the cooperation between the demand-side and the supply-side [of R&D] is weak. [...] The reason mentioned the most often by the interviewed stakeholders is the fact, that pharmaceutical business innovates predominantly in-house”, even when the R&D base is strong, e.g. in Life Sciences
• The Polish and international VC community has not “discovered” Łódź yet. Few local early stage VC funds exist (unlike in other major academic centers)
• Even though local academic centers appear to network well with leading universities in Europe, they often lack access to large, global corporate players in their areas of interest (e.g., pharmaceuticals) and to global tech-savvy VCs (e.g., Silicon Valley).

In terms of industry sectors to focus on during pilots (in particular, Pilot A), the Analytical Report points out to the pharmaceuticals (with the caveat outlined above) and medical equipment “verticals” as particularly worthy of attention: “The Pharmaceutical field also shows strengths on both demand and supply-side. It is well represented on the demand-side [of technology]; there are several huge players in the region. The specialization is supported by a very strong supply-side. Pharmaceuticals is one of the key competencies at the University of Łódź (UL). Moreover, the Medical University of Lodz (ŁMU), is ranked as the best university/research institute in the region; it has a strong competence in pharmaceuticals. [...]The closely related fields of medical technology and biotechnology are very strong on the supply-side, but are not [fully] utilized by the demand-side”. However, this can be considered as an opportunity to stimulate international demand, even though there are not many stakeholders in this domain in the region itself. These fields are especially strong in UL and ŁMU. “The supply-side expertise is supported by local innovation assets, specifically the BioNanoPark. However, the BioNanoPark has not fully utilized its full potential thus far”. Last but not least, one has to point out that stimulating demand for the ROP funds should go beyond the areas identified above. Especially outside Łódź, the region’s industrial base is fairly diversified; it appears that supporting innovative enterprises regardless of the industry they formally operate in is a rational policy.

The diagnosis and analysis additionally point to potential in the PRO base that is not being fully utilized, e.g., by more strongly shaping research outputs for regional adoption or by taking opportunities global (hence the need for Pilot B). This is a situation that is increasingly being addressed elsewhere, by improving the skills of the researchers to shape their research programs and results outputs for wider impacts e.g. for economic, social and environmental use. For example, the US the National Science Foundation (NSF) I-Corps program “prepares scientists and engineers to extend their focus beyond the university laboratory and accelerates the economic and societal benefits of NSF-funded, basic-research projects that are ready to move toward commercialization”.

Through I-Corps, NSF grantees learn to “identify valuable product opportunities that can emerge from academic research, and gain skills in entrepreneurship through training in customer discovery and guidance from established entrepreneurs”.

143
Capacity building programs to help CTTs and researchers to improve their commercialization skills are available in the EU through organizations such as ASTP-PROTON. However these are expensive and are aimed at individual rather than institutional development. Pros who received funding from the Incubator+ program have secured capacity building activities e.g. for a Boot Camp but these are ad hoc activities. Poland still lacks a national level program that would align with the EU strategy for Education and Training and leverage on other established initiatives such as Poland500 and the Incubator+. An opportunity exists to pilot a regional capacity building program that would help to release the existing potential of the PROs at an international level, increase understanding of how to shape research programs for the regional markets and potentially provide the basis for a national scheme delivered by individuals who have gained training experience on similar programs abroad.

**Expected level of interest in and support for Pilot B (the I-corps – type program)**

The local CTT leaders believe that the I-Corps – type program would be highly beneficial to the Łódź area universities and their research team. They observe that no existing program addresses the entrepreneurship skills at the universities in such a comprehensive way, and therefore the program should be differentiable from other initiatives. They also think that, well executed, the program could result in a marked change in the approach to commercialization taken at the local HEIs. From the perspective of the CTTs and the university SPCs the I-Corps program is therefore very beneficial.

The CTT heads are also convinced that the university rectors will see the advantages of the program. Its goals dovetail with the government’s intention to introduce the 4th mission to the university agendas. In addition, the program offers good public relations for the HEIs. In sum, the belief is that the rectors will be supportive of the program.

In the view of the CTTs, the researchers’ interest will not be overwhelming initially (there is many different programs being offered to them), but that, over time, their interest can be built up. It is assumed that initial class of 5-7 research teams can be built up from among the three local schools (approximately 2 per each university).

A snapshot of the region’s capabilities is reflected in the SWOT table below.
## SWOT of Lodz’s regional innovation ecosystem

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Priority</th>
</tr>
</thead>
</table>
| • (A) An outreach organization to liaise with business in place (Centres for Business Innovation)  
• (B) Examples of successful technology licensing and spinoff | • (A) The CBI organization’s track record in stimulating demand for innovative projects appears limited  
• (B) Low awareness and a lack of skills in the research base to recognise and realise research opportunities. | HIGH |
| • (A) Capable and motivated CBI staff  
• (B) Motivated researchers and established TTOs | • (A) Skills and capabilities to stimulate demand for good R&D projects among business appears limited at CBI  
• (B) Existing TT opportunities are not catching the attention of Global corporate and venture investors. | MEDIUM |
| • Alignment between local sectors and research strengths | • Local companies innovating ‘in-house’ despite the presence of a R&D provider | LOW |

<table>
<thead>
<tr>
<th>Opportunities</th>
<th>Threats</th>
<th>Priority</th>
</tr>
</thead>
</table>
| • (A) Interviews with CBI staff indicate the presence of many potentially innovative companies in the region  
• (B) Technology Transfer projects emerging from the ‘Incubator+’ program.  
• (B) Recently established linkage to the NSF I-Corps program. | • (A) Continued poor level of education among entrepreneurs on the details of local programs  
• (B) Current academic metrics still make a focus on academic outputs more important than applying new skills to commercialising research. | HIGH |
| • (A) Opportunity to significantly strengthen the role of CBI in stimulating demand for attractive innovation projects  
• (B) The drive towards more entrepreneurial education under the EU’s ET2020 and Principals of Innovative Doctoral Education. | • (A) Potential difficulty in restructuring the mission of the CBI  
• (B) Lack of follow on funding to sustain the action. | MEDIUM |
| • (B) Networks and linkages developed under Poland500 | • (B) National trainers do not remain in the public sector to transfer their skills to others | LOW |
Target groups/
stakeholders

<table>
<thead>
<tr>
<th>Pilot A</th>
<th>Pilot B</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Selected local entrepreneurs</td>
<td>• Researchers, tech-based</td>
</tr>
<tr>
<td>• The MO (in particular, the MO’s Centres</td>
<td>entrepreneurs, and CTTs from the Łódzkie</td>
</tr>
<tr>
<td>for Business Innovation and Center of</td>
<td>region</td>
</tr>
<tr>
<td>Services for Entrepreneurs)</td>
<td>• Research groups implementing their</td>
</tr>
<tr>
<td></td>
<td>Incubator+ projects</td>
</tr>
<tr>
<td>• CTTs at local PROs</td>
<td>• Potential trainers from the local</td>
</tr>
<tr>
<td></td>
<td>business innovation ecosystem.</td>
</tr>
</tbody>
</table>

Instrument and Financing

The key mechanism used during the pilot for both Pilot A and Pilot B will be the implementation by the MO under the financial umbrella of the ROP. It is assumed that some changes to the ROP will enable those instruments to be put into place.

Pilot A

Pilot A could be funded in the following way (referenced points refer to Pilot A description in Section 3):

- Activity 1 a. and 1.b were performed with the funding from the WB engagement
- Activity 2.a. (building of the database) would be funded as part of the ongoing activity of the CBI staff (after the extension). This occurred with the WB team’s supervision and guidance
- The source of funding of activity 2.b. is to be determined. The WB team provided guidance as to the structure and the nature of content of the collateral materials. The cost of developing and producing such materials should be borne by the MO (exact source of funding is to be determined)
- As for Activity 3, the following funding structure is being proposed:
  - The designing of the proposal “fiche” document for the EU commission was accomplished by the MO with guidance from the WB team
  - The “new” CBI project will be funded from the new perspective ROP according to the rules approved by the EU Commission on the basis of the proposal “fiche” document submitted by the MO.

It is clear that the “new” CBI formula should not be part of the broad export-promoting initiatives of the MO (or at least the internationalization and R&D objectives should be clearly separated). A new funding formula needs to be found. The MO suggested that this might be financed outside of the customary ROP “competitive” formula (i.e., a formula involving an initiative of special strategic importance for the region).

Pilot B

First, the MO has agreed that supporting CTTs from the ROP is possible (one has to prove that such aid will improve their situation). Second, the MO feels that the best way to structure the program
would be as a program not subject to the competitive rules (and not subject to the competitive tender regulations). Third, for such a program the universities are expected to contribute 15% of the money. There are VAT issues to be considered (is VAT a qualified expense or not?). The SPC option (see Section 3) could be advantageous from the standpoint of VAT regulations.

Two high-level strategies for financing should be considered. One would involve changing the ROP (then, given the procedures, the support could be available in early 2020). The other possibility would be not to change the ROP, and proceed with the decision of the MO management board. Either option requires a brief description of the proposed program (in the form of a fiche) to be provided by the MO.

Risks

<table>
<thead>
<tr>
<th>Pilot A</th>
<th>Pilot B</th>
</tr>
</thead>
<tbody>
<tr>
<td>• A possibility that meaningful changes to the ROP may be technically and legally difficult to implement (or will take a significant amount of time to implement).</td>
<td>• Longer than expected time to generate interest at the universities (both among the research teams as well as among the rectors)</td>
</tr>
<tr>
<td>• Local businesses continuing to prefer to pursue the national-level programs to fund their R&amp;D commercialization projects (i.e., the low uptake is not a cause of low level of education, but rather reflects the very nature of the local business and their needs).</td>
<td>• Finding the governance formula that will make it possible for the universities to collaborate</td>
</tr>
<tr>
<td>• Potential difficulty to re-staff the CBI team (it appears that, after the end of their current contract some of them may not re-apply for continuation of the CBI program)</td>
<td>• The ability to make the program I-corps branded</td>
</tr>
<tr>
<td></td>
<td>• The long-term impact and sustainability of the action</td>
</tr>
</tbody>
</table>

Mitigation Measures

<table>
<thead>
<tr>
<th>Pilot A</th>
<th>Pilot B</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Both risks can be assessed relatively early in the piloting process through a series of meetings with businesses and the MO; if they do materialize, no further effort will be expanded in Pilot A.</td>
<td>• Assuming a sufficiently long time to recruit the teams and execute positive PR campaigns at the universities</td>
</tr>
<tr>
<td></td>
<td>• Using the SPC formula to mitigate the risk</td>
</tr>
<tr>
<td></td>
<td>• Should NSF not be interested in lending its brand to the program, the next best option should be considered (i.e., implementing the program with NSF-trained practitioners)</td>
</tr>
<tr>
<td></td>
<td>• Training by itself is helpful in raising awareness and initiating longer term culture change. However, unless the learning is applied to research projects then it may have little impact on the amount and value of research brought to market at regional, national or global levels. For example, all I-Corps Team members also are expected to invest significant time and effort in their projects outside of the university/laboratory</td>
</tr>
</tbody>
</table>

|
environment. It will be important to embed the training into R&I activities e.g. by linking it to the Incubator+ series where the TRL of projects is systematically increased and also to metrics for academic career advancement.

- Sustainability is always a challenge for training programs unless they can find a long term sponsor. For that reason the model used by the US NSF should be examined as well as opportunities to make the program either self-sustaining to funded through the budget of a national level institution such as a Ministry for Science or a Research Funding Agency.

## Outputs

The following outputs are anticipated from the pilots:

<table>
<thead>
<tr>
<th>Pilot A</th>
<th>Pilot B</th>
</tr>
</thead>
<tbody>
<tr>
<td>An updated and simplified operations manual for the CBI enterprise support program including an outreach strategy (redefined mission/role, KPIs)</td>
<td>Development of a training curriculum and list of international certified trainers (Lean LaunchPad, business model canvas, customer development, go to market, value proposition, etc.)</td>
</tr>
<tr>
<td>Delivery of a capacity building program for the team implementing the new/upgraded program</td>
<td>Training of trainers’ sessions delivered (based on established modules from the I-Corps program)</td>
</tr>
<tr>
<td>Solicited feedback from enterprises on the new application and targeting process</td>
<td>Piloting of regular commercialization training sessions (targeting both research teams as well as personnel of regional TTCs)</td>
</tr>
<tr>
<td>A draft fiche including recommended changes to the ROP</td>
<td>A draft fiche including recommended changes to the ROP</td>
</tr>
</tbody>
</table>

## Indicators

These indicators should be compared to the present baseline/trend to try and assess the added impact of the action.

<table>
<thead>
<tr>
<th>Pilot A</th>
<th>Pilot B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of take up of ROP support from local enterprises</td>
<td>Number of trainers able to deliver the curriculum and train others (train the trainers)</td>
</tr>
<tr>
<td>Number of funded projects with the local PROs as subcontractors/research partners</td>
<td>Number of modules/courses delivered</td>
</tr>
<tr>
<td>No of researchers successfully completing training</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Number of research projects identified for commercialisation activities linked to the training program</td>
<td></td>
</tr>
<tr>
<td>Number of technologies brought to market directly linked to the training program</td>
<td></td>
</tr>
<tr>
<td>Value of the return to the PRO e.g. licensing revenue, research contracts with industry</td>
<td></td>
</tr>
</tbody>
</table>

**Timeline**

The estimate for Pilot A timing is approximately 2-4 months (including the diagnostic and design phases).

It is estimated that setting up/ implementing one cycle of Pilot B would take between 6 and 12 months. Such a program should then be monitored for at least 5 years to gauge impact.

**Budget**

The exact size of the proposed budget to implement the target intervention is to be determined though detailed work with the MO (to be finalized by the end of June 2019). It is preliminarily estimated that the total budget for implementing both Pilot A and B will be under PLN 10 M.

Main Pilot A cost categories would include, among others:

- Small team of CBI personnel for a period of up to 3 years
- Promotion and educational materials
- Building and maintaining a database of innovative businesses

Pilot B costs are estimated at about PLN 1M per each cycle, with two cycles envisioned as a true “pilot” over the 2019-2021 period. The main cost elements include:

- The fees and expenses of the team performing the first cycle of training
- Compensation scheme for trainers in subsequent cycle(s)
- Promotion of the program at the universities
- (possibly) Some budget to enable the execution of the program (e.g., travel expenses to see potential clients/partners, etc.)

**Issues to be further explored**

With regard to Pilot B, it is recommended that a consultation take place with national policy makers to see if the proposal anticipates or duplicates their own planned activities and to ensure that, if successful, Pilot B can be considered for future national level funding.
Appendix 3. Capacity building

3.1 Workshop: Research Commercialization Workshop for University Researchers

Overview

The one-day, capacity-building workshop for the seven universities\(^*\) from three regions took place at Łódź University on January 17\(^{th}\). 12 research teams amounting to 42 scientists participated in the workshop, and together with specialists from Technology Transfer Offices from various universities close to 50 people attended the workshop. The workshop provided a hands-on practical overview to the National Science Foundation’s ‘I-Corps’ methodology for rapid commercialization. It covered wide spectrum of topics, mostly orbiting around the Business Model Canvas, and ranging from fleshing out the value proposition, through customer ecosystem mapping, revenue model building, and finishing with the session on potential financing sources, practical tips on how to design project funding and quickly evaluate value of the research project (agenda attached as Annex to this document). The workshop was delivered by Whitney Hischier and Dariusz Wiatr.

The objectives of the workshop were as follows:

1. Understanding of the lean launch process
2. Determining product market fit
3. Managing stakeholders
4. Optimizing revenue models

Key take-aways

During the workshop experts invited by the World Bank explained in detail how good practices in commercialization of research projects at the universities look like using the Business Model Canvas approach. In particular the messages included:

1. Content
   a. The workshop covered the topic of using Business Model Canvas to describe Research Teams’ projects. During the workshop a wide variety of tools was used to engage the research teams, among them: lecture, presentations by the teams, working within teams, pairing up with different teams, one-on-one consultations with experts.
   b. The workshop was based on the National Science Foundation’s methodology and delivered by NSF-trained US-based expert with an addition of Polish investor giving insights on Polish financial market and sources of potential financing.
   c. Business Model Canvas is the basic approach to describe the research projects, yet many research teams are not familiar with it.
   d. The workshop emphasized a number of key elements of BMC, an approach tailor-made for beginner BMC user:

\(^*\) Universities invited from Podlaskie Region (3): Białystok University, Białystok Medical University, Białystok University of Technology, from Łódzkie (3): Łódź University, Łódź University of Technology, Łódź Medical University, from Dolnośląskie (1): Wroclaw University of Technology
i. Understanding
the idea of holistic lean launch process to describe research project in a
concise and standardized way,

ii. the need to flesh out the value proposition of research projects and the way
to do it, which for some teams remained vague,

iii. approach to define the product and how to design it for the particular existing
market,

iv. how to structure the relationships with stakeholders – both customers and
potential partners on the way to the market,

v. how to optimize the revenue structure, how to evaluate the research teams
with an idea, and how to approach the investors.

e. Thanks to the workshop the research teams were able to better determine the
product-market fit, which included more targeted thinking about the applicability of
their research on early stages of technology development and quick market scanning
in order to identify the needs on the market.

f. Researchers received comprehensive guidance on how to build and maintain
relationships with their key stakeholders, specifically how to define the target
audience for their research, how to identify and approach potential clients, how to
measure the competition on the market and identify existing competitors, how to
search for and establish cooperation with companies delivering similar products.

g. The workshop offered support to the research teams on defining the revenue
structure, which helped researchers to answer key questions concerning the revenue
stream, such as: how to identify the available funding for the projects, how to
structure the funding of the project (grants vs. investors), how to approach investors
and evaluate the research projects.

2. Feasibility and relevance

a. The workshop was key for the researchers, who in general have the knowledge on
possible commercialization paths, yet do not have the clarity and experience how to walk
through the commercialization process. Therefore hands-on support in developing their
projects and guidance in how to go about the commercialization is required both at their
level, and at the level of Technology Transfer Offices. Especially when the reward system
for scientists does not carry incentives to commercialize, the knowledge should be made
available to the interested researchers,

b. The workshop was useful for Technology Transfer Offices as it provided them with a range
of practical tools to support the commercialization processes in research teams at the
universities they are active,

c. Polish research teams require further support in basic skills, inter alia on creating
presentations, delivering them in front of large and English-speaking audience,
networking, market research, etc.

d. There is a clear need to continue this type of workshops in the long term as it addresses
an important gap in Polish R&D&I ecosystem, and will prove helpful in commercialization
efforts at Polish universities.

Feedback after the workshop

The quick survey done by the WB team and disseminated by Technology Transfer Office intermediaries
showed that people’s opinions after the workshop were either good or very good. Participants
appreciated the quality of invited experts and their competence, found their knowledge useful, and
rated the knowledge as highly needed and critically useful. They also highly valued the interactive
formula of the workshop that made it easy
for the participants to answer their questions and clear all the remaining issues. In particular the key
learning points highlighted by the participants included:

1. Better understanding how Business Canvas work and its importance in presenting research
   projects to an outside eye, in particular:
   a. What is the value proposition and why it matters
   b. How to map the customers ecosystem
   c. How to structure the revenue model and build partnerships
2. Participants appreciated one-on-one mentoring by skilled expert and some teams liked the
   feedback from other research teams
3. It was underlined that the workshop presented a clear way to commercialize the research
   outcomes, which was new to a number of participants
4. Participants underlined that inputs on financing and practical tips on how to evaluate were
   extremely helpful in thinking about project finance
5. Participants also appreciated a number of practical tips in marketing, e.g., how and when to
   talk to people during conferences and events, or how to prepare presentations
6. One issue that was as a downside of the workshop was too high difficulty level of presented
   tasks, yet once adjusted the workshop would be an ideal tool for Polish researchers to support
   their commercialization efforts.
Annex 1. Workshop agenda

9 – 9.30 am  Intro exercise and overview of the day

9.30 – 10.30 am  Intro business model canvas- review of each portion of the Business Model Canvas and revise templates that teams will bring to the program. Updated templates should more accurately reflect current vs. desired state of startup

10.30 – 10.45am  Break

11 – 12 pm  Customer discovery and product market fit- identify target customers, develop questionnaires for interviews and practice interviews. Refine value proposition for each customer segment.

12 – 1 pm  Working lunch

1 – 2 pm  Teams present templates- each team has 5 minutes to present their business model canvas with 5 minutes of feedback from the faculty and other participants.

2 – 3 pm  Mapping the customer ecosystem and workflow- each team will map the existing stakeholders in their ecosystem and flows of information and money. Assess which stakeholders are most powerful/problematic and form a plan to interview them.

3 – 4 pm  Building a revenue model and partnerships- review different revenue models and best fit for each of the different business models. Review framework on assessing partnerships

4 – 5 pm  Pitching to investors- Dariusz will share lessons learned pitching to investors in Poland.
Annex 2. List of participants’ research projects

<table>
<thead>
<tr>
<th>No.</th>
<th>Project</th>
<th>University</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Hybrid superhydrophobic and anti-icing coating – HybridCoat</td>
<td>University of Łódź</td>
<td>This project aims to produce the technology of manufacturing and deposition of superhydrophobic and anti-icing coatings that would be applied to bridges, aquatic infrastructure and other architectural constructions to achieve extremely low adhesion of ice.</td>
</tr>
<tr>
<td>2.</td>
<td>Electroless matt-nickel coating of steel items</td>
<td>University of Łódź</td>
<td>Technology developed under this research project makes it possible to obtain decorative, durable nickel coatings on every type of steel surfaces. The process does not require electricity and may be cheaper than electrodeposition.</td>
</tr>
<tr>
<td>3.</td>
<td>NBS: Biostimulation agent for bioremediation of organic pollutants</td>
<td>University of Łódź</td>
<td>Stimulation of already existing nature-based solutions in order to decontaminate the natural resources (soil, water)</td>
</tr>
<tr>
<td>4.</td>
<td>Material and Commodity Sciences of Textiles</td>
<td>Łódź University of Technology</td>
<td>The team works in the field of circular economy, especially on products connected with environmental protection, and focuses on technologies based on material recycling and application of biodegradable and renewable polymers</td>
</tr>
<tr>
<td>5.</td>
<td>Mesenchymal Stem Cells Reactor</td>
<td>Łódź University of Technology</td>
<td>The team works on technology allowing for the development, construction and commissioning of a high-performance flow reactor for the cultivation of mesenchymal stem cells (MSCs)</td>
</tr>
<tr>
<td>6.</td>
<td>Memory Support</td>
<td>Łódź Medical University</td>
<td>Novel, patient and caregiver oriented, user friendly application was invented by the research team to support and improve their quality of life and to contribute to reduce costs related to AD disease and care.</td>
</tr>
<tr>
<td>7.</td>
<td>The Third Age Does Not Exclude</td>
<td>University of Białystok</td>
<td>The problem of old age and aging is an extremely important problem from the point of view of pedagogy. There is a need to develop new educational programs (including cultural ones) addressed to seniors in</td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td>Institution</td>
<td>Description</td>
</tr>
<tr>
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<td>--------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>eSense</td>
<td>University of Białystok</td>
<td>The project targets the phenomenon of overstimulation by access to too much relevant information and aims to produce the tool that would help researchers to select only relevant information</td>
</tr>
<tr>
<td>9</td>
<td>Innovations in regenerative medicine and immune regulation</td>
<td>Białystok Medical University</td>
<td>Recently, tissue-engineered scaffolds have been utilized in wound healing studies and offer promising possibilities in the treatment of deep wound including burns and diabetic wound ulcers. However, to date, a limited number of acellular dermal scaffolds are available on the market. This project aims to change that.</td>
</tr>
<tr>
<td>10</td>
<td>Molecular tools for cancer treatment</td>
<td>Białystok Medical University</td>
<td>The research team aims to develop a technology that would allow for searching for molecular tools that in turn would be used as an innovative way to treat the cancer</td>
</tr>
<tr>
<td>11</td>
<td>Bee MedCare</td>
<td>Białystok University of Technology</td>
<td>The research project is focused on developing a new, effective and 100% natural origin veterinary product used to treat bee disease, specifically American Fulbrood</td>
</tr>
<tr>
<td>12</td>
<td>RehaProf - Professional Equipment in Rehabilitation and Prevention</td>
<td>Białystok University of Technology</td>
<td>Musculoskeletal disorders are in the top five diagnostic groups in the EU and lead to significant costs arising from the necessity of health care and social support. An early intervention and well-designed exercise program can help in restoring and maintaining the balance and reducing muscle pain by reducing muscle tension at rest</td>
</tr>
</tbody>
</table>
3.2 Workshop: Working Practices in Monitoring the Capacity of R&D Infrastructure

Background to the situation

Public Research Organizations are being encouraged to embrace a third stream mission and engage in more Open Access activity by making their equipment and facilities available to external users. External users are other Higher Education Institutions as well as commercial enterprises and government agencies.

When making services available to external users, PROs need to comply with EU regulations concerning State Aid to ‘undertakings’ and take care that they are not distorting the market. Compliance with this ruling has taken 3 main forms in the EU:

1. Keeping the maximum annual usage for economic purposes to 20% or below (≤ 20%) on an annual basis - so called ‘ancillary use’. This is the approach that is being contemplated by many PROs in Poland.
2. Not setting a 20% ‘cap’ on economic use but demonstrating that a market rate is being charged for service so that there is no market distortion. This is the approach adopted by PROs in the UK.
3. Demonstrating ‘de-minimis’ or an R&D State Aid exemption.

Both the first 2 approaches can present significant challenges: demonstrating ≤ 20% use requires both an agreed methodology and a monitoring system that may be rather complex while establishing a market rate for specialized services can be difficult.

PROs in Poland face an additional problem that new equipment and faculties that were purchased using public funds under regional and national operational programs 2007-2013 including OP Innovative Economy, OP Infrastructure and Environment, OP Development of Eastern Poland, must comply with the ≤20% annual use for the full depreciation period or they run the risk of the ‘monitoring and recall’ mechanism being invoked where part of the grant used to buy the equipment must be returned (‘clawed back’).

It is important to stress that 20% is not a ‘legal limit’ and that Polish PROs are permitted to exceed it. In fact, exceeding 20% may make sound financial sense if the additional revenues generated are in excess of the ‘recall’ amount and it can be demonstrated that the market is not being distorted e.g. by showing that a ‘market rate’ is being charged for services. The Ministry of Economic Development has stressed recently that Polish PROs should not be afraid to exceed 20% but rather should undertake scenario analysis so they understand clearly the ‘break-even point’ where the revenue from using>20% capacity for economic use would match the potential recall amount. If the revenue generated from exceeding 20% is lower than the ‘recall’ amount then the PRO may decide to internally impose a 20% cap or further investigate how much they would have to increase the price of their services before break-even was achieved and if the market would bear this price.

In 2017 the Ministry of Economic Development and Finance and the Ministry of Science and Higher Education issued detailed guidance to the PROs on when and under what circumstances a return of grant money might be triggered, including the funding streams involved, the accounting periods to be monitored, the type of research infrastructure affected, the type of economic activity involved and the amount of grant financing that would have to be returned under different circumstances, e.g., related to the original aid intensity.
The guidance notes issued were very detailed and brought a lot of clarity to the situation. However, what is still required is an accepted methodology for monitoring ancillary use so that annual usage for economic purposes can be demonstrated with confidence by a PRO. The main issues in developing such a methodology are outlined below as well as an approach to developing a methodology based on aspects of Good Practice published by the EC.

Additionally, the note includes a case study from Kaunas University of Technology (KTU) in Lithuania which describes an implemented approach that was agreed upon and approved by its Ministry for Science.

Input in to this note from universities affected by the ‘Monitoring and Withdrawal Mechanism’ would be welcomed, in particular on the problems that need to be over-come to enable confident Open Access use of RIs in Poland.

Comment and questions can be sent to:

- Jerzy Jakub Toborowicz jtoborowicz@worldbank.org (Polish language), or
- Lisa Cowey l.cowey@t3i.co.uk (English language)
Developing a methodology for monitoring economic use of RIs: Starting points and published Good Practice

An exact method for calculating the ‘capacity’ of research infrastructure that might be used for economic purposes has not been specified by the EC or by the Polish Authorities. It has been indicated that the method of calculating should reflect the specificity of the infrastructure and that an income based approach is not acceptable.

The Commission has indicated that ‘capacity’ can be determined in several ways, e.g. the number of working hours/days and area or volume of space utilised. However, a very clear starting point for developing a methodology is Article 19 (a) of the Commission Communication (2014 / C 198/01) - Framework for state aid for research, development and innovation. This article both clarifies the meaning of ‘non-economic’ and ‘economic activity’ and makes clear that the state aid framework needs to be considered “if the economic activity is consuming the same inputs (such as materials, equipment, labour and fixed assets) as non-economic activity”. These four inputs therefore form a strong basis for both calculating and monitoring capacity.

Suggestions on how to calculate the efficiency of research infrastructures are also included in the guidelines provided for in the Annex to European Commission Decision C (2013) 8699 of 10 December 2013r. “Guidelines on the application of Point D.4 of Article 6.2 of the General Model Grant Agreement for Horizon 2020 and the Euratom Research and Training Program 2014-2020 (direct costing for large research infrastructure)”. These may be found in the Annotated Model Grant Agreement for the Horizon 2014-2020 version of 21 April 2017, in the part concerning Art. 6.2 pt. D.4 operating costs of ‘large research infrastructure”,

This document identifies good practices for calculating and documenting costs associated with a given source of funding in the context of large research infrastructures:

- **Depreciation (for capitalized costs):** accounting statements accompanied by the beneficiary’s depreciation policy (under its usual accounting principles), to show adequate calculation of the potential use of the asset (total productive time based on full capacity) + calculation of the useful economic life of the asset, evidence of project time (or units of actual usage for the action) and evidence of the actual use of the asset for the action;
- **Rental or lease of the research infrastructure:** specific explicitly labelled rental or lease invoice/contract; adequate calculation of the potential use of the asset (total productive time based on full capacity) + calculation of the useful economic life of the asset, evidence of project time (or units of actual usage for the action) and evidence of the actual use of the asset for the action;
- **Personnel:** time recording (without prejudice to the need for persuasive evidence of actual involvement in the action);
- **Maintenance and repair (including calibrating and testing):** specific explicitly labelled invoice relating to the research infrastructure + project time (or units of actual usage for the action);
- **Consumables, materials and spare parts:** specific explicitly labelled invoice relating to the research infrastructure, if available, or stocktaking; actual consumption for the action (based on analytical cost accounting) or project time (or units of actual usage for the action);
- **Facilities management, including security fees, insurance costs, quality control and certification, upgrading to national and/or EU quality, safety or security standards:** specific explicitly labelled
invoice relating to the research infrastructure + project time (or units of actual usage for the action);

- Energy and water: specific explicitly labelled invoice relating to the research infrastructure + project time (or units of actual usage for the action);
  - The energy consumption of a specific research infrastructure can be obtained from the measured consumption (e.g. number of kilowatts per hour of use), as stated in its technical specifications or provided by the supplier or an independent body. These specifications must be identifiable and verifiable.
  - Direct measurement allows to determine a ‘cost per unit of use’ covering all the actual direct costs relating to the operation of the research infrastructure being used for the action, i.e. depreciation costs plus necessary operating costs of the research infrastructure.

In the document the Commissions states that the cost per unit of use must be calculated as follows:

\[
\frac{\text{all capitalized costs of the research infrastructure} + \text{all operating costs of the research infrastructure}}{\text{total annual capacity}}
\]

This document states that the unit of use must correspond to:

(i) the **time of use** expressed in hours, days or months and supported by evidence or

(ii) the **number of accesses**, for which supporting evidence may take the form of records or electronic log of units-of-access provision.

The calculation must take due account of real constraints (e.g. opening hours), but must reflect the research infrastructure’s full capacity and include any time during which the research infrastructure is usable but not used or any unit of access available but not used.

Finally, in the context of the **Framework Rules**, the European Commission has stated that, in terms of resource efficiency, the following should be taken into account:

1. **Fixed assets (and their depreciation period)**
2. **Labor costs of the work force (and its appreciation)**
3. ‘**Materials**’ (overheads including power and water utilities)
4. **Equipment (and its amortization)**

In the methodology below this simpler approach of just considering these 4 main variables has been proposed. However, projects should consider if they need to consider the wider set of inputs outlined for large research infrastructures. Projects also need to decide what they will consider to be a ‘**unit**’ e.g. a full building, a laboratory or a set of testing equipment.

**Step 1: Auditing to establish a 100% annual capacity figure**

The starting point for calculating 100% capacity is to undertake a full audit of the RI.

1. **Fixed Assets**
For a building this should clearly identify common space (corridors, stairwells, washrooms etc.) as well as space used just for ‘independent research’ (non-economic research), and space used for both economic and non-economic purposes. The depreciating period of this space should be calculated as this will form the time-frame for future monitoring as well as the annual depreciation of the building as this will be used to calculate annual capacity.

2. Labor

Labor costs should take into consideration the salary of all personnel who will work in the RI. A useful starting point for further calculations of ‘full annual capacity’ is the EC guidelines of 1720 hours per year being a Full Time Equivalent (FTE). A sensible estimation should be made for increasing costs of labor over future years.

3. Materials (Overheads)

Overheads should include all the costs necessary to run and maintain the infrastructure. The calculation will normally include power, water, sewage, waste disposal services etc. It may also include the costs of external services connected with the operation of the building. Where these costs are also likely to increase in coming years this should be estimated.

4. Equipment

All equipment bought in the framework of the grant should be audited. When then calculating annual capacity for future years, related to the depreciation period of the building, an amortization period should be used for each unit of equipment. It should be noted that the equipment is likely to reach the end of its amortization period before the building reaches the end of its life-time. One equipment is fully amortized its value will not be included in the annual capacity although the costs of running and maintain it will still be reflected in the cost of ‘materials’.

Calculating the annual sum of each of the four inputs will give the full annual capacity, expressed as a monitory value. This forms a clear starting point for monitoring % of annual capacity used.

The commission has indicated that ‘capacity-share’ can be determined in several ways, e.g. simply via the number of working hours/days, the % of space being used or at a more sophisticated level via the monitoring of the individual inputs.

Step 2: Monitoring

The Commission has stated that "In order to avoid granting State aid for economic activity by financing non-economic activities from public funds, costs and financing of economic and non-economic activities should be clearly separated”. Separating the two activities requires appropriate monitoring.

Monitoring needs to take place on an annual basis and for the full duration of depreciation and at the level of a sensible ‘unit’. A unit might be a full RI if this would be required to deliver a service; it might equally be a laboratory or a group of equipment. If multiple units are defined with differing building depreciation periods then there will be a need to consider each unit individually or to apply the longest period to all the infrastructures.

The Commission has indicated that:
Monitoring the use of infrastructure can be based on:

- the area of the research infrastructure (or a defined sub-unit of the whole);
- the time of its use e.g. hours allocated to delivering a service
- operating costs of a unit
- Labor costs associated with the unit
- or other indicators (one or several), most appropriate for the possible use of the infrastructure.”

But that the monitoring mechanism cannot be based on income or income from economic and non-economic activity.

Monitoring on the basis of the selected indicators needs to be possible using financial and accounting records and other documents, on the basis of which it is possible to confirm the proportion of use of business or non-economic infrastructure. Proof of appropriate allocation of costs, financing and revenue may be the annual accounts of the relevant entity. Some of the documentation that could be used to confirm use has been given under the H2020 Large Research Infrastructures extract above. It is sensible to examine the level of existing documentation and then to consider if the investment in to a more detailed monitoring system will be covered by the revenue generated by the contract research activity.

In particular, when considering a rather complex system requiring significant investment in to new software and processes it is worth assessing if this would enable confident utilization at > 20 capacity and significant revenue generation that exceeds the claw-back, covers for the investment and generates additional revenue that can be invested back in to the PRO.

Defining ‘units’ by linking them to specific services to be delivered is a very logical approach provided the supporting monitoring documentation can be collected at this unit level. When detailed monitoring information is not available, e.g. the delivery of power or water cannot be accurately estimated or directly monitored at the level of individual pieces of equipment, then it may be necessary to reach a compromise between directly monitoring the components of delivering an individual service and clustering services based on their location and their apportioned share of overheads based on space and time utilization.

Based on input from the Ministry of Economy, any methods employed should seek to combine transparency, accountability, consistency. In addition, they should not be formulated in a way to artificially circumvent the situation e.g. by moving equipment out of the building in order to remove it from the monitoring process. It should be remembered that the original intention and purpose of a grant would normally form a central part of any legal considerations related to monitoring of its use.

Step 3: Forecasting demand for your services

In Poland, PROs who are intending to cap ancillary use at 20% need to forecast demand and indicate to the authorities that they will not exceed 20% of full capacity. However, forecasting demand will also enable scenario analysis when considering the possible benefits of exceeding 20% when additional revenues exceed claw-back.

A straight-forward approach is to define the ‘services’ that will be placed on the market and then forecast the inputs discussed above for each service namely:
➢ Fixed assets (using the associated spatial area)
➢ Labor (Individuals involved and their time)
➢ Overheads (either directly consumed or as a proportion of the service’s area)
➢ Equipment (deprecations and time in use to prepare for and deliver a service)

Once the ‘value’ of a service has been calculated, based on the outputs above, it is necessary to estimate the annual demand for each service.

Once all services have been defined, and annual demand and associated ‘value’ calculated then this will yield an annual value for economic activity. Comparing this to the full annual capacity will enable a Beneficiary to demonstrate that economic activity does not exceed 20% full capacity. Alternatively, if the economic value does exceed 20% of full capacity it should then be possible to investigate pricing models needed to ensure that the additional revenue generated for the PRO will be at least as great as the ‘claw back’ or to decide which services should be scaled back to bring the capacity figure to 20% or less while maximizing revenue generation for the PRO.

Step 4: Demonstrating that the monitoring system can be implemented.

Based on the indicators that the PROs has elected to monitor there will be a need to demonstrate that they can be calculated at the level of detail demanded by the methodology. Reference may need to be made to existing accounting practices or to the use of new methods of monitoring, collecting and sorting information e.g. by the introduction of new booking systems, software or other reliable data collection methods.

Introducing software to monitor use: example KTU Lithuania

Kaunas University of Technology in Lithuania has established an online ‘booking’ system for all research equipment with a replacement value of > 3K EURO. The ‘100%’ capacity can be adjusted for each piece although the default is 40 hours/week. Three different categories of ‘user’ are defined: internal academic research, external academic research and external ‘economic’ research by enterprise and other entities where their use falls in to ‘economic use’.

Advantages:

- the system allows the university to monitor centrally the use of equipment and to demonstrate that overall use of any piece of equipment is 20% or less of its full capacity;
- the system allows for a ‘repair and maintenance’ fund to be established by allocating a % of the costs of all three types of activities to be paid to the fund;
- the system encourages external users and supports Open Access and the universities third stream mission;
- Transparency and full accountability are ensured.

Disadvantages:

- The approach relies on:
  - an IT system and an online catalogue of equipment that took >3 years to develop internally and
accurate booking of equipment by all users including full time/ permanent university researchers

• The approach does not enable to university to move to > 20% use if demand exists from external users because it is not using a market rate for services (see below).

KTU Lithuania adopted their approach because the greatest driver was finding a way to retain and maintain the equipment bought with EU funds. The booking system allows them to allocate a % of the 'booking' to a repair and maintenance (R&M) fund. Establishing a market rate to enable > 20% use proved very difficult and has so far proved unnecessary as demand for external use of faculties by enterprises has remained low in Lithuania (< 20%).

For more information on this approach see the accompanying Case Study.

Adopting the Market Rate

UK universities have adopted a 'market rate' approach to delivering contract research. This means that they do not distort the market and thus no undertaking would be in receipt of indirect state aid. This approach needs to be used if a PRO intends to exceed the 20% cap. It is important to note that taking a ‘not for profit’ approach to delivering research services, e.g. charging below market rates, does not circumvent the issue of state aid rules as it has the potential to distort the market. In a similar way, claiming an exemption based on ‘Technology Transfer’ is also highly risky as Technology Transfer has a very clear and narrow definition within State Aid framework rules and should not be confused with ‘Knowledge Exchange’.

Advantages of this approach

• UK universities do not have to limit ancillary use to 20%.
• UK Universities are free to generate revenue that can be reinvested in to their ‘not for profit’ organizations’

Disadvantages of this approach

Establishing a market rate based on fEC+ a margin is difficult. The UK approach to fEC is now based on TRACT (Transparent Approach to Costing). The 'market rate'/ 'margin' approach was the result of a lengthy and comprehensive consultation process led by UK government (BIS - Department for Business Innovation and Skills and HEFCE - Higher Education Funding Council for England).

UK universities may have been influenced in this approach by the lack of investment in the RI and equipment from Structural Funds as this type of EU funding for RIs and associated restrictions have not been available to most of the UK and as a result a ‘withdrawal’ / claw-back penalty is not part of their financial equation.

Early clarification points for a Polish PRO:


• Does Poland have a framework for fEC?
• Does Poland or the EC have an approved method to establishing a market rate for R&D services that have no clear benchmarks in the commercial sector?

Citing the 'De-minimis' or R&D State Aid exemption

This approach is most commonly used when a grant is being made available to an undertaking e.g. an innovation voucher, originating from the PRO and being given to an SME. It requires the PRO to ensure that the undertaking can confirm that state aid is de minimis in the relevant reporting period (total amount of funding received by an organization does not cumulatively exceed €200,000 over a three year period).

Early clarification points for a Polish PRO:

• Under what circumstances might a PRO need to prove de minimis or R&D exemptions for contract research activity?
Case Study on Point - Contract Research: Kaunas University of Technology (KTU) Lithuania

Kaunas University of Technology (KTU) is a public research university in Lithuania and the largest technical university in the Baltic States. It has an academic staff of almost 3000 employees and nearly 17,000 students.

Due to its research focus and strength KTU has always had strong laboratory and equipment infrastructure. The University also used some EU structural funding to establish Santaka Open Access ‘Valley’ (see case study below).

KTU set a long term goal of achieving a 70% : 30% split between students and researchers (internal users) and contract research (external users) utilizing its research infrastructure. To address the issue of EU funding having been used to buy some of the equipment KTU made the decision to deploy a ‘20%’ model and has not sought to demonstrate a market rate. This approach fits the main driver for increasing Open Access which was to establish a repair and maintenance fund for university equipment from both the funding obtained from external contract research and grants associated with internal academic research. The need to generate such funding has become acute as there is has been no money from government sources for this purpose for several years and the expected flood of Open Access users into the Valleys have failed to materialize. Lithuania discovered that international companies from other EU MS tend to place their orders for contract research ‘within an 18 km radius of their head office’.

The KTU Open Access initiative is under-pinned by three pillars:

1. **An online 'catalogue' of equipment and services with associated pricing**

   KTU made a very substantial audit of their capital equipment (internally defined as being worth > 3K EURO), photographed each piece and then allocated each to one of 3 categories:

   A: Supervised at all times.

   B: Research use that does not need to be supervised.

   C: Standard supporting equipment e.g. volt-meters etc.

   Each piece of equipment in the catalogue can be internally edited. Each entry has multiple fields including where it is located, who is responsible etc. Each owner can manage and define usage including how 100% capacity is defined (see more under-pricing and capacity).

   There are three tiers of user access to the equipment entries. The National Agency can see everything. The Open Access coordinator in each faculty can see equipment under their jurisdiction. The third level is the owner of an individual piece of equipment who can edit the entry and manage the bookings. The

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106See https://apcis.ktu.edu/en/site/index
booking interface is a simple screen showing 7 days and 24 hours. Each owner can define 'regular' usage of equipment.

2. **IT equipment ‘booking’ system**

KTU developed its own software that collects quite detailed information on use of equipment and includes a pricing algorithm. The software is central and integrates with the university's existing IT system so that it can deliver requests and alerts to heads of departments and reports on usage to administrative units including finance.

Each piece of equipment in the system can be 'booked' to an internal or external customer. Approval for the bookings is made by the head of the relevant faculty.

Each 'booking' on the system is automatically associated with a % of the price being designated to the R&M Fund. The % depends on the type of user (internal or external) and the category of equipment being used. The booking system is now being intensively used with some 20 thousand bookings in the last year.

Data collected by the system includes:

- the piece of equipment and its grade
- the transfer path of funding e.g. from Department A to Department B;
- the designated supervisor of the equipment
- who is responsible for paying
- where the money is coming from (project, student grant etc.)
- hours used
- price
- % owed to R&M fund
- type of use e.g. post grad research/ under-grad studies

The system includes a series of check-points including physical safety (is the equipment safety record up-to-date? Is suitable supervision available?) and a financial check (the booking needs to be approved by the head of the department responsible for allocating funds. Department Deans receive a daily email that they must check and respond to).

At the moment, only category A equipment is being tracked.

It took KTU three years to develop the system using non-dedicated, internal resources. They initially tried to outsource the development but this ended in failure. The National Agency took a similar approach with an identical result having allocated 1 Million to ‘Gate’ to produce the system (see https://gate.ac.uk/).

The system may now be made available on commercial terms to other Lithuanian Universities who are interested in joining a central Open Access system. The KTU programmers are also interested in launching a spinoff but so fast have struggled to find an investor.

3. **Relationship managers plus an Open Access manager in each faculty**

The relationship managers are responsible for generated and managing demand from external users, including other research institutions. They respond to the online inquiry system and liaise closely with the Open Access managers to ensure bookings are made for external users.
Pricing model and the 100% capacity issue

KTU initially investigated how to establish a 'market rate' for services and found this difficult. Equivalent services were not being offered by the commercial sector and legacy equipment made it hard even to set rates for similar but differently aged pieces of internal equipment.

They then tried to undertake FEC (full economic costing) by allocating known operating costs to equipment in a lab. They found it hard to allocate or measure power and water use by individual pieces even when using the rating on the equipment. KTU went so far as to investigate investing in to water/power monitoring equipment from a company based in Israeli who offered equipment monitoring solutions. This was deemed impractical.

Ultimately KTU made a decision to look at capacity and then built a pricing algorithm in to their IT system. Defining 100% capacity was strongly debated as some equipment can be automated and so could be used 24/7 while other equipment needs full supervision and so can only be used when a technician is available. Finally, some equipment is so specialized that 'normal' use is very occasional and it would be unrealistic to expect this to change through Open Access.

The IT system now allows each equipment 'owner' to define 100%. The default setting is 8 hours a day, 5 days a week. However, this can be changed to better reflect the specific piece of equipment and its category. The settings and the use is then automatically recorded leading to a clear and documented use by different type of users. The price is now set based on a mix of a standard charge for the equipment plus a service charge for support and supervision if needed. Pricing thus exists at equipment and laboratory level.

KTU have received a visit from the Commission. It was not an official inspection but KTU practice is considered a Good Practice model.

Case study: Establishing regional R&D valleys and Open Access Laboratories – Lithuania

The R&I potential of Lithuania includes a pool of nearly 18 000 R&D professionals. One third of research and experimental development research is carried out at universities.

Using Structural Funds Lithuania has developed a network of five R&D ‘valleys’. The valleys are based in Vilnius, the capital of Lithuania, in Kaunas, the country’s second largest city and industrial centre, and in Klaipėda, the non-freezing seaport city. They comprise Santara Valley (Vilnius), Sunrise Valley (Vilnius), Santaka Valley (Kaunas), Nemunas Valley (Kaunas), Maritime Valley (Klaipėda). Each valley specializes in a number of scientific research fields and involves one or more of the main Lithuanian research institutions.

Nearly 300 M Euros of structural funds have been invested to the development of the infrastructure of R&D valleys. The investment was made in regard to the expertise already possessed by research institutions in order to strengthen their capacities in respective R&D areas. For the new financial period of 2014-2020, structural support will be narrowed and aimed at national priorities distinguished under national Smart Specialization Strategy.

According to the national rules, all R&D resources located in the valleys must be available for the public on the basis of Open Access.

For this reason, universities and research institutes in the valleys must establish Open Access centres and provide access to their R&D resources. Other entities which possess R&D equipment are also eligible to establish an Open Access centre.

The Regulation of Management of Open-Access Centres defines the following aspects:

- Principles of formation, management and the manner of use of the resources;
- Equipment use time ratio between separate subjects, maintenance costs, and the accumulation and investment of the funds received for the use of resources;
- Indicators of activity effectiveness;
- Principles of intellectual property protection;
- Provisions on solving the disputes.

This strategic investment of structural funding has permitted the development of high-quality infrastructure and premises at the Open Access Centres—infrastructure for research, innovation and new technology development and comfortable conditions to establish new technology-oriented businesses—offices, labs, business incubators. So far, more than 26 Open Access centres have been created in Lithuania—centres of excellence with modern equipment, advanced technologies and world-class scientific potential. They specialize in laser, nanotechnologies, semiconductor physics, electronics, engineering, biotech, energy, environment, ICT and agriculture.

The high-quality infrastructure and premises at the Open Access Centres enable private companies to undertake experimental research and/or measurements, construct prototypes, create new advanced research-based products and improve existing technology. They also enable firms to access professional assistance in research, technology and innovation issues by working with both researchers and qualified technology transfer professionals.

Alongside high-quality infrastructure and premises, the valleys structure also helps to promote:
- Access to skills and networking—concentration of scientists, researchers, developers and university academia, close collaboration of knowledge-intensive businesses with science and study institutions, opportunity to be co-located with other companies in the same sector (clusters) and region.
- Research excellence—Open Access labs, R&D projects supported by EU/state, application of research results in industry and business.
- Increased international competitiveness

For a list of the Open Access centres see: [http://apc.mita.lt/open-access-centres](http://apc.mita.lt/open-access-centres)

Workshop Summary

A World Bank (WB) team conducted a one-day workshop under the DG REGIO-financed *Catching-Up Regions Poland* engagement. The workshop was led by Anwar Aridi (Private Sector Specialist, Finance, Competitiveness and Innovation Global Practice) and included a team comprising Lisa Cowey (Technology Transfer Expert, Consultant), Juan Rogers (Public Policy Expert, Consultant), Mladjan Stojanovic (Innovation Expert, Consultant), Voytech Nosek (Innovation Expert, Consultant) and Jerzy Toborowicz (Local Innovation Expert, Consultant). The Team was complemented by an expert Whitney Hischier, who joined the event via WebEx. The workshop took place on May 7th in Warsaw World Bank office.

The objective of the workshop was threefold and responded to the request by the regional stakeholders during the WB Technical Assistance engagement. During a Team’s visit in the regions the stakeholders expressed their expectations towards the TA capacity building and asked for a workshop that would support them in their public policy mission. The objective of the capacity building workshop was to:

- share good practices and design principles of regional policy interventions in the innovation, technology transfer and entrepreneurship space,
- enhance the design and implementation quality of innovation and entrepreneurship support instruments,
- share relevant international experiences related to the proposed regional pilot programs developed by the WB team with the regional counterparts.

The workshop was well-attended by a range of counterparts relevant to the regional public policy making from a number of institutions in selected Polish regions. This workshop has been designed for regional authorities responsible for designing and implementing the Regional Operational Programs (ROP), including those responsible for monitoring their implementation, results and impact, as well as for the Technology Transfer Office management and staff, who complement the supply side of R&D&I ecosystems. In total a dozen institutions\(^{107}\) represented 4 regions\(^{108}\), and 25 participants were present at the workshop, with additional ones joining the workshop online. The selection of participants was based on the list of the key stakeholders from the regions the WB is implementing its TA to ensure quality intake of designed solutions in the regions.

The workshop centered on the particular role of public policy – the design of innovation and entrepreneurship (I&E) support instruments, and was delivered by experienced facilitators. The workshop provided a hands-on practical overview to the principles of designing the regional support programs. It covered a wide spectrum of topics, mostly orbiting around the policy making, its origin and rationale, justification, selection of final instruments, specificities of technology transfer and its role in the innovation policy of the region, and presented a number of European good practices of quality support instruments. Overall the workshop helped regional stakeholders to design and implement future tailor-made, well-targeted innovation and entrepreneurship support instruments and to prepare to implement their own pilot projects designed under WB engagement. The workshop agenda is attached as Annex to this document.

\(^{107}\) Out of which: 4 Marshal Offices, 2 Universities, 2 development agencies, 1 cluster, 1 ministry, 1 city council and the European Commission

\(^{108}\) These were: Dolnoslaskie, Kujawsko-Pomorskie, Lodzkie, and Podlaskie
First session on innovation policies focused on the origin and the process of innovation policy making. In the first session concerning the principles of the design and implementation of innovation policies the expert – Juan Rogers – explained the variety of key topics to innovation policymaking, ranging from the origins of public policies, focus and rationale of government interventions, various technical assistance programs, and target beneficiaries. The key to good policy making, as presented by the expert, is clear problem identification, done with the quality analytical work, which is at the center of each well-designed policy instrument. For this reason the expert presented the profiles of different SMEs, to be able to match various types of instruments and SMEs’ function.

Second session concerned the technology transfer in the innovation policy with relevant public policy implications. The next session centered around the role of the technology transfer at the universities, and discussed the process of technology transfer and the interaction of the academic or public R&D with industry. Expert underlined the key importance of quality labor force in the innovation policy, and the role of administration in creation of conditions to turn the innovations in the impactful companies in the economy. Another issue concerned the design procedures for both technology assistance programs, and the roles of TTOs and SPCs, and the pilot programs along with their key performance indicators and evaluation frameworks that will allow public administration to make decisions about their continuation/cancellation.

Third session concerned presentations of European good practices selected for the participating regions. The following session cast more light on three institutions that at some point in their history identified and tackled problems similar to the ones of participating regions. First good practice came from the Czech Technical University in Prague and concerned the cooperation of students with the industry by creation of the platform for industry-originated challenges. Students are incentivized to take up the challenges posted by the companies by: (i) the possibility to work on an interesting real-life problems, (ii) money, and (iii) student credit points (ECTS). The second good practice originates from Serbian Innovation Fund and aims at setting up a fund responsible for implementation of agile programs designed to support the companies and research teams with well-designed innovation support instruments. Third example was the US National Science Foundation’s program I-Corps targeting university-based research teams to support their development via supplementing them with tools and techniques to rapidly come up and validate the hypotheses by interviewing potential future customers of their technologies and innovations. All three examples were selected based on the alignment with designed solutions for the regions under the WB TA.

Final session of the day concluded with a discussion on particular regions representatives concerning their pilot projects. The workshop closed with the summary from the WB Team of the whole day to instigate the discussion amongst participants on how to use the conclusions in their pilot programs. The overall reception of the workshop was very warm, participants underlined that the material presented at the workshop will be used in the implementation phase of the pilot programs, especially for monitoring and evaluation purposes of the pilot programs.
Annex 1. Workshop agenda

Introduction

Enabling innovation in firms, and particularly in SMEs, remains a challenge across Europe. Many SMEs do not have in-house R&D facilities or capacity, and while R&D skills are present in public research organizations (PROs), it is hard to bridge the gap between public and private sectors so that they can collaborate effectively and bring technology to market. The gap between public and private sectors is evidenced across the developed world. Countries that have tackled the problem most effectively recognize that differences in cultural norms between public and private sectors can be a strength for innovation. Rather than trying to change either group, they focus on deploying ‘Bridges, Brokers and Boundary spanners’ to bring the two groups together for mutual benefit, designing instruments and support structures for effective intervention and increasing the skills of individuals and groups to better engage in their innovation ecosystem.

This one-day workshop focuses on the principals of design and implementation of impactful regional innovation support programs including performance indicators. It uses established interventions from other countries to illustrate the main points and offers opportunity to meet and discuss several programs that have been successfully implemented in other regions.

Target participants

This workshop has been designed for regional authorities responsible for designing and implementing the Regional Operational Programs (ROP), including those responsible for monitoring their implementation, results and impact, as well as for the Technology Transfer Office management and staff, who complement the supply side of R&D&I ecosystems.

Workshop Objectives

- To share good practices and design principles of regional policy interventions in the innovation, technology transfer and entrepreneurship space,
- To enhance the design and implementation quality of innovation and entrepreneurship support instruments,
- To share relevant international experiences related to the proposed regional pilot programs developed by the WB team with the regional counterparts
## Agenda

**Venue:** Warsaw, World Bank Office  
(53 Emilii Plater str., 9th floor)  
**Date:** 7th May 2019

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.30 – 9.00</td>
<td>Registration and coffee</td>
</tr>
<tr>
<td>9.00 – 9.15</td>
<td><strong>Who is who?</strong> Introductions and quick presentation of the participants</td>
</tr>
</tbody>
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| 9.15 – 10.30| **Session 1: Principles of design and implementation of Innovation Policies**  
**Presenter:** Juan Rogers, Professor of Public Policy at the School of Public Policy, Georgia Institute of Technology  
- Profile of SMEs  
- Rationale and Focus of Government Intervention  
- Types of instruments by SME function  
- Technology Assistance Programs  
- Group Activity  
Q&A |
| 10.30 – 11.00| Coffee break                                                            |
| 11.00 – 12.30| **Session 2: Technology Transfer and Technology Assistance Programs in Regional Innovation Policy**  
**Presenter:** Juan Rogers, Professor of Public Policy at the School of Public Policy, Georgia Institute of Technology  
- Tech transfer and the interaction of Academic/Public R&D with Industry  
- Design procedures  
  - Technology Assistance Programs  
  - Pilot programs  
- Evaluation frameworks and Indicators  
- Group Activity  
Q&A |
| 12.30 – 13.30| Lunch                                                                   |
| 13.30 – 15.00| **Session 3: What, why and how? Case in point: relevant innovation support programs and their main design elements**  
- Case 1: Czech Republic Co-FIT program - Vojtech Nosek WB Consultant, UNICO Co-founder and CEO  
- Case 2: Proof of Concept in Serbia - Mladjan Stojanovic Technology Transfer Coordinator, Innovation Fund Serbia  
- Case 3: I-Corps National Science Foundation US - Whitney Hischier Haas School of Business, University of California Berkeley, US National Science Foundation’s I-Corps program Instructor |
| 15.00 – 16.30| Roundtable discussion: Moderated by Juan Rogers and Lisa Cowey (WB Consultant, IP Expert)  
Summary and conclusions: Anwar Aridi, Project Task Team Leader |

**Languages:** English and Polish (simultaneous translation)
Profile of the Presenters

**Juan D. Rogers** is Professor of Public Policy at the School of Public Policy, Georgia Institute of Technology. Prof. Rogers is an internationally recognized expert in design, implementation and evaluation of public policies that focus on science and technology in economic development, competitiveness and uses of science and technology to address special social or economic needs. His research addresses knowledge intensive policies, knowledge flows, science for policy, science, technology and innovation (STI) policy, public management of STI, modeling and evaluation of R&D process, public expenditure reviews, public policy functional analysis, public policy impact evaluation, knowledge management and organizational change in the private and public sectors, technology transfer and diffusion policies and creativity in science and engineering. He publishes regularly on these topics in academic journals such as *Research Evaluation, Research Policy, Journal of Public Administration Research and Theory, Local Government Studies,* and the *Journal of Engineering Management.*

Dr. Rogers has developed new methodologies of policy analysis, especially for science, technology and innovation policy evaluation and public expenditure review analysis. He has served as a consultant on public management of STI policy and research evaluation in several countries (Argentina, Chile, Colombia, Dominican Republic, Perú, Poland, Uruguay, Saudi Arabia, United Arab Emirates, China, South Korea and United States). He has conducted policy advice and analysis projects and written reports and policy briefs on public expenditure review, technology extension, STI policy and evaluation, and management of research for national and regional governments in Argentina, Chile, China, Colombia, Mexico, Poland and Uruguay, and for the World Bank and the Inter-American Development Bank.

Professor Rogers received his PhD in Science and Technology Studies from Virginia Tech and is an electrical engineer from the University of Buenos Aires, Argentina.

**Whitney Hischier** is on faculty at the Haas School of Business, University of California Berkeley, and an instructor in the National Science Foundation’s I-Corps program. As a lecturer at Haas, Whitney teaches entrepreneurship, consulting, and strategy. Prior to teaching, Whitney was the Assistant Dean for Executive Education at Haas and grew the business 10x over a decade. Before returning to academia, Whitney was management consultant in the healthcare and life sciences practice at Deloitte Consulting, systems integration at KPMG London and globalization group at ABN Amro in Amsterdam. She began her career working at a 4-person startup in a backyard pool house. She holds an MBA from Haas with a Certificate in Healthcare Management, and a BA from Stanford University in International Relations.

**Mladjan Stojanovic** has graduated from the University of Belgrade, Faculty of Technology and Metallurgy, and at the Delft University of Technology. He got his Professional doctorate in Engineering from process design and heterogeneous catalysis in the biofuels production processes. As a researcher he coordinated and consulted in projects under EU framework program, World Bank, national Dutch and Serbian projects and with the private sector companies.

He possesses expert knowledge from the wider area of entrepreneurship, specifically in patent system, evaluations of economic and business models and project management. He works on the development of funding mechanisms for innovation projects that stimulate cooperation between R&D organizations and private sector companies. Currently, he leads the Technology Transfer program and the Innovation vouchers scheme at the National Innovation Fund of Serbia.
Lisa Cowey has worked in technology commercialization for over 26 years and has direct experience of high-tech spinout, equity fund raising and successful trade sale with ventures in the UK, USA and Germany.

For the last 12 years she has worked extensively with PROs across the European continent to help them identify, protect and valorize their research results with a particular emphasis on use of Intellectual Property. Her current portfolio includes the Balkans, the Baltics, Ukraine, Turkey and Azerbaijan. She also supports WIPO in Turkmenistan and Kyrgyzstan on their IP Policy for universities initiative.

Lisa has a PhD in Physics from the University of Oxford, an MBA from Oxford Brookes University Business School where she specialized in University Industry technology Transfer and a Diploma in IP (Law and Practice) from Bournemouth University Business School IP Unit.

Vojtech Nosek has graduated from the Charles University in Prague, Faculty of Science where he got his doctorate in Social geography and regional development, focusing on quantitative modelling. He has coordinated several research projects financed from Czech Science Foundation.

He is a co-founder of the company UNICO.AI, which helps to connect universities, private companies, and investors utilizing big data and artificial intelligence. Before founding UNICO.AI, he was a Technology Transfer Manager at the biggest technical university in Czechia, Czech Technical University in Prague. He led, as a manager, several research projects including collaborative projects financed from European Commission such as Horizon 2020. He also co-founded and managed the University Centre for Energy Efficient Buildings, which was financed from Structural funds (approx. EUR 30M).

He is accredited member of European Knowledge & Technology Transfer Society and specializes in intellectual property valuation, licensing, university spin-off creation, and pre-seed and seed funding of early stage projects. He also coordinates start-ups co-owned by UNICO.AI and development of Experts.ai platform.
Appendix 4. The Challenge Driven University: Possible benefits and challenges

The Challenge Driven University: Possible benefits and challenges

Introduction

The ‘Challenge Driven University’ places problem solving of real world challenges, by the undergraduate/masters student body, at the heart of a University’s first stream (educational) mission. The challenges can cover economic, social and environmental issues and are characterized by being trans-disciplinary, i.e. requiring skills beyond the knowledge of a single discipline. Challenges are typically developed by external partners from a variety of organizational types including industry, NGOs and civil society.

Techniques that are typically embedded in the education program include an understanding of approaches to physical or analytical/virtual prototyping based on proven approaches e.g. Integrated Product Development and Agile Methods; the focus is on understanding and applying iterative prototyping approaches rather than purely on production of working hardware. Students work in groups and team skills, including knowledge transfer between disciplines, is typically part of course assessment and grading.

As Challenge Driven Education (CDE) has developed so have associated rankings for Universities who have adopted this approach. These offer an alternative to traditional rankings based on tradition teaching and research outputs.

Relevance of Challenge Driven Universities for development of innovation ecosystems

Many transition economies face similar challenges in developing innovation ecosystems that rely on HEIs to be the knowledge provider for economic development. Typically challenges and characteristics are present in the Lower Silesia region and can be summarized as below:

1. **Innovation (or the ‘3rd stream mission’) is not a priority for Rectors.**

   Education is the main driving force behind a university’s finances and can be regarded as the ‘cash cow’ product. Research acts as a reputational enhancer, attracting both better students and ‘teachers’ to the HEI. Ranking of the universities is based on educational and research performance.

   In contrast, ‘innovation’ can be seen as a ‘problem child’ of the HEI BCG matrix. It does not provide strong financial returns (as demonstrated by licensing revenue), it is not present in the metrics of many national ranking schemes, it does not yet provide a reputational enhancement except at highly entrepreneurial universities, it requires specialized skills and many years of investment to even allow the activity to break even at research rich HEIs. Rectors could be forgiven for feeling that ‘divest’ or ‘out-source’ would be a reasonable ‘business solution’ for commercialization of research. In the meantime, it is often viewed as a ‘bolt-on’ to the 1st and 2nd missions, rather like ‘go faster stripes’ or a ‘spoiler’ on a family saloon car.

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109 The terms ‘cash cow’ and ‘problem child’ are taken from the Boston Consulting Group Matrix (BCG Model).
2. **Innovation is not a priority for many academic researchers**

Career advancement for academics is primarily based on publication in peer reviewed papers. Academic researchers made a conscious decision to join this system, often many years ago; it fits to their personalities, value system, needs and job satisfaction and enjoyment. Changes to the system, e.g. ‘incentivizing’ academic researchers to engage in development work for SMEs, can simply create an environment that does not make best use of the inherent skills and personalities of the established employee base and many researchers simply choose not to engage. Changing the system is likely to attract a different type of researcher to join the HEI base but it takes time for changed composition to be reflected in organizational cultural change and a more entrepreneurial university – arguably a decade or more.

3. **Established HEI structures do not promote multi-disciplinary working**

Traditional HEI organizational structures tend to silo researchers in proximity to others using similar equipment and studying similar related phenomenon. Design of external research funding can encourage individuals to seek partners from further afield but this cannot be imposed and the path of least resistance will always be to work with those in closest proximity where there is most in common.

4. **Established HEI funding norms do not promote ‘iterative’ working and multiple prototyping**

Research funding applications tend to focus on achieving the end result with greatest value for money. This tends to screen out approaches that would otherwise investigate different options e.g. a multiple prototyping approach at the TRL3 level rather than a single prototype that is then validated in the relevant environment before being commercialized.

5. **Academic freedom and conflicting demands on their time can make it hard for academic researchers to engage in contract/ collaborative research against a business led time-frame.**

Enterprises frequently complain that they struggle to get academic R&D teams to meet commercially driven time-lines. While it is true that there are always conflicting demands on academic time, e.g. from teaching and exams, it is also the case that academic freedom often enables a researcher to ignore the deadlines for R&D results, requested by a company, when other activities feel to them to have a greater priority or provide de more interest and reward e.g. travelling to attend a conference.

A Challenge led University or ‘challenge led education’ directly addresses a number of these issues.

1. By placing the problem solving activity squarely in to the education (1st stream) activity it becomes a priority for rectors and for the teaching/ research staff.
2. Undergraduate and master level students include those who are interested to enter non-academic careers, including the next generation of leaders of industry, and who respond to a different set of incentives and rewards, compared to the older, established academic body.
3. Multidisciplinary teams of students can be ‘constructed’ by the university and this is non-negotiable by the students themselves.
4. Student grades are partially dependent on making a strong effort to work with those from other disciplines.
5. The non-negotiable approach to tacking problems, including clear deadlines, is attractive to the companies setting the challenges, who have previously struggled to engage with more senior researchers, who have the freedom to exercise their own norms towards collaborative and contract research.
6. The teaching includes understanding and trying out different approaches to prototyping as part of the core education process and so iterations and multiple prototypes (physical and virtual) are strongly encouraged.

7. By embedding ‘innovation’ in to the teaching mission, a culture of entrepreneurship can be sown that eventually permeates the entire HEI and helps to recruit a new generation of researchers to the institution who will respond positively to changing assessment metrics and ‘incentives’ to engage with the 3rd stream mission. Innovation becomes part of the HEI engine and is no longer perceived by Rectors and Researchers to be ‘go-faster-stripes’.

Possible challenges and mitigation for implementing the CDE model with particular reference to the Lower Silesia region project

1. Role of the MO in proposing the concept.

A true CD University needs to be established by its rector, senior manages and the teaching staff. It cannot be truly developed by an external organization such as a MO. The MO may be able to facilitate and to assist in setting up a pilot Challenge Driven Education program e.g. as a simple pilot and by linking the HEI to external CDUs and local partners.

Question: How did the idea for a CDU arise in the region and who is leading it? Are champions identified inside the university?

2. Time-scale and complexity in fully establishing the concept

Even one new HEI course that is challenge driven will require a significant investment in to design time by academic staff and need to involve a number of departments from different disciplines. It will need a champion to go out and secure the partnership with external groups who will generate the challenges. If the course is to be accredited this may also take significant time. It will also need to be ‘sold’ to the student body as an alternative to more established and accepted methods of learning and qualification.

Guides on how to establish the concept do exist and there are now many CDU and courses in existence that could be visited and perhaps engaged in the design and rollout.

Question: Can the concept be ‘piloted’ inside one or more of the universities? Has this idea been explored?

3. Resistance to change from the HEI

‘If it aint broke then don’t fix it’ may be the response from rectors to a suggestion that they change their established educational approach. Resistance to change and fear of failure from established lecturers is also likely. Clear drivers for educational reform in Poland will need to be identified e.g. the proposed merging of some universities and the need to develop a USP for survival. The project is also likely to need a small group of interested individuals from several departments who are interested and willing to try a pilot experiment.

Question: Is there clear support inside the PROs for the concept and for the work needed to implement a pilot?

Pros and Cons

Because the CDU has to be led from within then unless a very senior internal champion can be identified then it may pose a higher risk of early failure for new project than an initiative that can be almost entirely
directed from outside with support from the MO e.g. setting up a simple proto-lab with 24/7 access (Milestone: Facility Open). However, if the support from the HEI can be secured then it provides them with a much less passive role in the project than an external Proto-lab or a Valorization Platform, and once an educational course is established, there is only a low risk that it will be left under-promoted, which could be the case for a Proto-Lab if there is no one actively promoting the facility to the student body. Thus there may be better performance of long term M&E indicators e.g. students enrolled on a CD course vs. students using a proto-lab.

The initiative breaks a lot of new ground for Poland although there are emerging examples e.g. InnoEnergy Master’s School programs, led by InnoEnergy in Kraków. It comes at a moment when educational reform is rising up the agenda for the country and Rectors are actively seeking ways to secure the survival of their HEIs and are open to new ideas to strengthen their position, particularly with regard to teaching.

Educations itself is a entirely familiar subject for the HEIs and one they are more likely to feel confident and interested in that, for example, valorizing research or selling equipment based services on the open market in compliance with State Aid Rules. They are therefore more likely to actively engage then they might on other topics.
Annex 1 Challenge Driven Universities – examples to be considered for a study visit or other capacity building exchanges

Challenge Led Universities and Problem Based Learning – historical evolution and examples

Rational for selection and sources of information

The examples described below were initially identified through the March 2016 NESTA Paper ‘The challenge-driven university: how real-life problems can fuel learning’. Information from this paper has been updated and extended where possible (September 2018). The examples summarized were selected because the models and approaches they describe have been established for sufficiently long to demonstrate impact, sustainability and refinement. They have also been selected in preference to some other good examples from China and the Far East as being accessible to the universities in Poland under the new World Bank led program e.g. for a study visit.

Emerging suggestions for study visits/ exchanges

None of the examples outlined below emerges as a full ‘Challenge Led University’ but all offer excellent examples of Problem Based Learning at faculty and course level. In continental Europe, integrated models of PBL are most clearly visible at the Norwegian University of Science and Technology (NUST) with their ‘Villages’ and ‘Experts in Teamwork’ programs and at Aalto University with ‘Learning Challenge Aalto’ and the ‘Factories’. UK universities have adopted the PBL approach but, with the exception of the University of Lincoln ‘Student as Producer’, without linking this approach to a named model of delivery. As Aalto has been the target for a previous study tour it may be beneficial to consider NUST in Trondheim for a visit.

While not being explicitly a challenge led University, the enterprise strategy of the University of Warwick UK and the Warwick Manufacturing Group (WMG) have been a much studied model for universities seeking to become more entrepreneurial though a significant culture change, link their institution to the industry base and to make this a clear attraction for students for industry alike.

The US also favours a ‘branded’ model for their PBL approach although models do not vary significantly in their design and delivery. The US may be too far for a study visit but it would be worth further investigating the Olin Collaboratory Summer Institute to see if participation in the 2019 week might be an option for the CuR3 project group.

Introduction to Problem-based Learning and the ‘McMaster Model’

The ‘problem based’ approach to learning (PBL) was pioneered by McMaster University Medical School in the late 1960s. In response to changing demands on the profession, the curriculum was changed so that students learned collaboratively, working on real-life cases in small groups. This new self-directed group model has since been called ‘The McMaster Model’ and is now used in medical schools around the world; these include New Mexico and Taiwan. Harvard Medical School now also incorporates PBL into

110 Nesta 2016
their **New Pathways curriculum** (see below) and elements of the model have also been used in engineering and military colleges.

**Problem based learning (PBL)**

Under the McMaster Model, problem-based learning is quite different from “problem solving”, and the goal of the learning is not to solve the problem which has been presented. Rather, the problem is used to “help students identify their own learning needs as they attempt to understand the problem, to pull together, synthesize and apply information to the problem, and to begin to work effectively to learn from group members as well as tutors”. The main characterizes of the original McMaster Model approach are outlined below. It is important to note that this was specially aimed at medical students.

- **Small group learning**
  - Problem-based learning occurs in a tutorial-style setting and typically includes 7-8 student participants.
- **Faculty facilitation**
  - Each PBL tutorial is led by a physician tutor. The tutor aims to strike a balance between directing the tutorial's conversation, while actively soliciting student feedback to ensure that a student's gap in knowledge is addressed and remedied.
- **Use of patient-based cases**
  - Students are presented with a realistic clinical case during their first tutorial of the week. Students are expected to study and research the case and present their findings during that week's second tutorial.
- **Learning objectives**
  - Simply providing students with a patient case does not ensure that they will grasp the appropriate concepts. Each tutorial case is paired with a well-defined set of **learning objectives**, which are essential in ensuring that students address the correct content and identify their strengths and weaknesses in that particular content area.

For more information on the **McMaster Model** consult the information sources at the end of this document.
Examples of PBL courses

Europe

Scandinavian countries have been pioneers in higher education, with many institutions founded on the principles of continuous innovation, collaboration and inter-disciplinarity.

1. Aalto University: Learning Challenge Aalto and the ‘Factories’

Aalto in Finland is a fairly recently created university that has deliberately put CBL methods of this kind centre stage. The University was created out of a merger between Technology, Economics and Art Universities in Helsinki and now runs four interdisciplinary ‘factories’ - Design, Health, Media and Service, where teams of academics and students work with companies and communities to develop new products that respond to demand from the real economy.

The 4 Factories are designed to facilitate new forms of collaboration in an environment where academic teams, researchers and students work together with companies and communities. The themes of teaching and learning are an important part of the Factory activities – the new knowledge produced by research is smoothly transferred to teaching.

CBL is also at the heart of the Aalto School of Business summer program, Information Technology Program (ITP), part of the Learning Challenge Aalto. Learning Challenge Aalto is one of Aalto University’s four joint strategic development initiatives in the area of teaching and learning. The goal is to help teaching faculty at Aalto University to create and develop scalable educational concepts in the form of courses, which have integrated real life challenges involved. The initiative also aims to improve students’ work life capabilities and employability.

At the same time, Aalto is extending its CBL model to other parts of the world including East Africa.

For sources of additional information consult the information sources at the end of this document.

2. Norwegian University of Science and Technology: Villages and Experts in Teamwork

The Norwegian University of Science and Technology in Trondheim believes that ‘cross-disciplinary research delivers creative innovations with far-reaching social and economic impact’.

NTNU has most courses in Norway in technology and art and aesthetic subjects. Experts in Teamwork (EiT) is a master’s degree course in which students develop their interdisciplinary teamwork skills. The course is compulsory for all students in master’s programs and programs of professional study at NTNU and as part of their courses, students are required to join a ‘village’. NTNU offers about 80 villages, each with its unique village theme. The common factor is that all the village themes are linked with problem areas from society and working life e.g. ‘Biofuels - a solution or a problem?’, ‘Sustainable, affordable housing for all’, and ‘Portable technology and well-being’. Students prioritize the five villages with themes they would most like to work with, and they are assigned a place in one of them. In the village, the students are divided into smaller groups, normally of 5-6 people who work together throughout the semester. These student teams each define their own project related to the village theme. Each village is

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111 Nerland and Prøitz 2018
run by a professor who divides students into smaller groups to work on problems in their topic area. By applying their combined academic competence, they find answers to different problem formulations.

For sources of additional information consult the information sources at the end of this document.

3. Maastricht University

Maastricht University is the second youngest university in the Netherlands. All teaching at the University uses a problem-based learning model, and this has become one of the main attractions of studying there. Twelve to fifteen students discuss problems in group sessions, with one student appointed to lead the discussion. The students are given complex problems from everyday professional practice which they brainstorm and research both together and separately. This process is repeated every week until the problems are completed.

In essence the MU PBL process is composed of seven steps that are followed in groups of 10 to 15 students.

1. Discuss the case and make sure everyone understands the problem
2. Identify the questions that need to be answered to shed light on the case
3. Brainstorm what the group already knows and identify potential solutions
4. Analyze and structure the results of the brainstorming session
5. Formulate learning objectives for the knowledge that is still lacking
6. Do independent study, individually or in smaller groups: read articles or books, follow practicals or attend lectures to gain the required knowledge
7. Discuss the findings

The initial five steps are covered in the first tutorial. Students then work individually or in small groups on ‘their’ part of the problem, and come together in the second tutorial to discuss the results as a group.

Partially due to its innovative approach to teaching, Maastricht University was ranked sixth in the QS 2014 top 50 universities under 50 years old.

4. Geneva Tsinghua Initiative (GTI)

The Geneva Tsinghua Initiative (GTI) is a partnership between the University of Geneva, with its strong ties to Geneva’s international organizations, and Tsinghua University, China’s top university with its main campus in Beijing’s high-tech corridor, and another in Shenzhen, heart of the Chinese manufacturing ecosystem.

The GTI adopts a modern approach to open innovation characterized by:

- A focus on challenge-based learning inspired by real-world problems.
- Collaboration through multidisciplinary and multicultural teams.

All the GTI educational activities are designed with international exchange as a key component, between Switzerland and China, but also towards a network of labs in other parts of the world that address the SDGs, called United Labs for the Global Goals.

5. Centre for Research and Interdisciplinarity at the Sorbonne Paris
The Centre for Research and Interdisciplinarity at the Sorbonne encourages students to do most of their course work on unsolved problems on the cutting edge of science or social innovation, rather than only learning about existing knowledge.

The CRI’s main role is to promote new educational techniques and strategies to empower the students to take initiative and develop their own research projects. Mentors, research institutions, private companies, and foundations, such as the Bettencourt Foundation, provide the support for the student-created research projects and activities.

Recent expansion of activities at the CRI activities include:

- The new Institute for Learning Through Research (Institut Innovant de Formation par la Recherche – IIFR Paris Descartes / PRES Sorbonne Paris Cité) was inaugurated in March 2012 by the International Scientific Committee of the National Innovative Training Program (IDEFI) of the French Ministry of Research. The IIFR organizes different workshops, PhD courses, an executive program and launched a new Master Program in September 2014. In September 2013, the IIFR activities were awarded an UNESCO Chair for “Learning science”.
- The Citizen Cyberlab European Consortium (citizen science) was launched in September 2012 with funding from the EU 7th Framework.

6. Imperial College London and the Royal College of Art (RCA)

Imperial College London and the Royal College of Art (RCA) are two particularly innovative higher education institutions. For the last ten years, Imperial has been running the Energy Futures Lab - a cross-discipline, issue-based department aimed at tackling global energy challenges. It was established to bring together disparate fields of study that are relevant to energy including engineering, environmental sciences, computer science, business, policy and mathematics. The lab’s research is based around five themes - clean fossil fuels, energy infrastructure, low carbon transport, policy and innovation, and sustainable power and offers. The Lab has hosted a number of groundbreaking research projects, researchers are currently refining the design of fuel cells that use algae to efficiently and sustainably create energy (via the production of hydrogen). The Imperial Energy Futures Lab also offers an MSc in Sustainable Energy Futures which is accredited by the Energy Institute, the leading chartered professional membership body for the energy industry.

Imperial and the Royal College of Art also run a Double Masters in Innovation Design Engineering (IDE) which is well known for producing some of the best talent in the field. It’s a creative product development course which includes experimentation, design, engineering and enterprise, making use of multidisciplinary teams in the process. Unsurprisingly, the IDE course has been a catalyst for a number of innovative start-ups.

The IDE course has been successful in part because of its strong external relationships. Projects have been undertaken with companies such as Ford, Coca Cola, Airbus, BBC, Unilever and many others. Their flagship international module ‘GoGlobal’ takes students abroad for three week cross cultural, collaborative projects with academics and industry partners. Past projects have included: sports innovation with University of Technology, Sydney; social city software with KAIST, South Korea; exploring rural-urban migration issues with Tsinghua University, Beijing; the future of food at Tsukuba University, Japan; and the growth of the creative industries in Ghana.

7. University of Lincoln: Student as Producer
The University of Lincoln has challenge-driven education at the core of its teaching. Its ‘Student as Producer’ pedagogical approach promotes learning by doing and emphasizes the role of students as knowledge creators together with academics. The model has four key themes.

- **Discovery**: students learning through their own research and enquiry;
- **collaboration**: creating knowledge together with their peers and academics;
- **engagement**: becoming more involved in their discipline and production;
- **creating knowledge rather than consuming education**.

The approach was recognized by the UK’s Quality Assurance Agency (QAA) in the university’s institutional review in 2012. The QAA commented that the high levels of student engagement were directly attributable to the ‘Student as Producer’ concept.

The University of Lincoln also recently launched the **Lincoln School of Engineering** in collaboration with **Siemens Industrial Turbomachinery**. The school offers degrees that are tailored to the changing demands of the engineering industry, focusing on specialisms such as control systems and power and energy. Siemens Industrial Turbomachinery also provides scholarships and paid work placements to the most talented students. One of the most interesting features of the collaboration is that academics and Siemens employees are co-located, meaning students benefit from real-world practical experience as well as theoretical education.

**8. The University of Warwick**

The University of Warwick was founded in 1965. It has 29 academic departments and over 50 research centres and institutes, in four Faculties: Arts, Medicine, Science and Social Sciences. All the faculties utilise PBL.

Warwick marked its strategy with a wish to be ‘enterprising and outward-looking’ from its foundation. It sought to match academic excellence with relevance. This policy was not always popular in the late 1960s and early 1970s but when government decided to fund universities on a more differential basis in the 1980s, which led to sharp downward changes in centrally-provided grants, the University seized the opportunity to look at ways in which it could augment public monies with income generated through its own activities. This led in part to the success of the Warwick Manufacturing Group (WMG) and the university’s original strategic approach is now much embraced as a model for the modern enterprising university. It has been praised for its dynamism, quality and entrepreneurial zeal". President Clinton delivered his last major policy address on the campus in December 2000.

**Warwick Manufacturing Group (WMG) : Academic excellence with industrial relevance**

WMG was founded in 1980 to help reinvigorate UK manufacturing. WYG works to ‘improve the competitiveness of organizations through the application of value adding innovation, new technologies and skills deployment, bringing academic rigor to industrial and organizational practice’. WYG is seen as an international role model for how universities and business can successfully work together and has been much studied and visited by other groups seeking similar to adopt a similar model.

**Key facts about WMD**

- An academic department of the University of Warwick
- Employing over 600 staff including industrial secondees
• Working across seven research and education centers on the Warwick campus, with three more under development
• Delivering education programs in seven countries, and collaborating globally on research and development
• An annual program of £200m (industrial and in-kind support)
• 2,200 Master’s students and 250 Doctoral students
• Strong relationships with over 1,000 global companies
• Supporting 1,800 SMEs through dedicated programs
• To date, over 35,000 students have studied with us, from 75 countries

Warwick Medical School (WMS): Case Based Learning

Case-Based Learning (CBL) is at the core of the MB ChB curriculum and is integrated across all four years of the program. CBL is a learner-centered method of teaching and learning that WMS regard as ‘directed discovery’. It identifies what is essential to know about a patient case while encouraging students, individually and in small groups, to take an active role in identifying what they need to learn and how they can learn it. CBL also acknowledges that students have existing knowledge and experience which they can draw upon, including in contributions to group work.

The WMS have adopted CBL to support students in

• Integrating learning across the biomedical, social and clinical sciences
• Applying this learning to medical practice, including in the development of clinical reasoning and problem solving skills
• Developing team working, communication and professional skills
• Incorporating and building upon prior knowledge and experience
• Developing skills for self-directed learning.

The cases used in CBL are realistic, typically based on common conditions and reflect current clinical practice. CBL sessions are supported by interactive lectures, other small group sessions, clinical skills sessions, e-learning and experiences in the community, primary and secondary care.

See: https://warwick.ac.uk/fac/sci/med/study/ugr/courseinfo/structure/elements/cbl/

School for Cross-faculty Studies: Problem-Based Learning

The School for Cross-faculty Studies is the home for the University of Warwick’s increasing range of inter and trans disciplinary degree programs. The University’s primary Goal is to enable its students to succeed through the provision of a life changing education, an outstanding student experience and the development of a global perspective. The School for Cross-faculty Studies aims to achieve this Goal through the development and delivery of unique, innovative, and flexible courses which use problem based approaches to explore current issues of global significance from a variety of disciplinary perspectives. Through Problem-Based Learning, students learn to engage creatively and critically with a wide range of theories and methodologies to address the specific intellectual and practical questions in which they’re interested. This approach is built on the active development of research and professional skills from day one, so you’re prepared to move into the academic and professional worlds and make a difference.
Warwick Business School: Accountancy and Finance; Management Science; International Business

PBL is also used by the University Business School who have developed a Good Practice study.

See Case Study in Good Practice [https://warwick.ac.uk/services/ldc/resource/rbl/case/wbs2.pdf](https://warwick.ac.uk/services/ldc/resource/rbl/case/wbs2.pdf)

**Americas**

1. **Stanford University, School of Engineering: P5BL model**

Stanford School of Engineering’s P5BL model was designed to address two observed shortcomings in engineering graduates: a lack of cross-disciplinary communication, coordination and negotiation skills, and a narrow perspective of the job itself. Students on Stanford’s AEC courses (Architecture/Engineering/Construction) collaborate with students from other disciplines and in other continents on half-year construction projects, accountable to an industry leader. They are encouraged to use technology such as screen sharing and interactive whiteboards to aid in their collaboration.

**About P5BL**

P5BL is a methodology of teaching and learning focuses on problem-based, project-organized activities that produce a product for a client. It is based on re-engineered processes that bring people from multiple disciplines together.

Based on P5 Based Learning concept the AEC Global Teamwork Program and the P5BL lab. were designed.

**The AEC Global Teamwork Program**

- AEC Global Teamwork Program is a cross-disciplinary, collaborative, geographically distributed course offered over two academic quarters. It gathers students, faculty, and industry practitioners from Architecture, Engineering and Constructional management in a distributed learning environment including universities from Europe, Japan, Australia and the US.

- The course is structured along the lines of ‘a master builder’s atelier’. The industry mentors serve as the role of master builders, sharing their practical experience and knowledge with the students. The graduate students will fit the role of ‘journeymen’, and the undergraduate students act as ‘apprentices’.

- The mission is to educate the next generation professionals who know how to team up with professionals from other disciplines and at the same time, using the cutting edge information and collaboration

**The P5BL Lab -- The home of AEC global teamwork program**

The lab was designed based on the concept to provide a structure for modeling and coaching. It has a flexible learning space that can be reconfigured by faculty and students to facilitate learning and teaching activities.

Some features of the lab are:

- Modular furniture
- ISDN, wireless, and Internet-2 links
- The floor and wall perimeter has a grid of network and power sockets that enable connection of computers in any location of the learning space
- All the PCs in the lab are equipped with videoconference tools
- Large touch screen Smart-Board
The P^BL Team

Gathering expertise from cross disciplinary such as architecture, structural engineering, constructional engineering, computer science, networking, cognitive science, linguistic, education and social science. The team consists of:

- **Research Students**: Graduate students of these disciplines from Stanford University, Berkeley University, Sweden and Germany.
- **Faculties**: Faculties from Stanford, Berkeley, Japan, Asia, Europe. They are intrigued and interested in the challenges that the global teamwork brings to the learning and working environment.
- **Industry Partners**: Partners from the industry who volunteer their knowledge into this program.

For sources of additional information consult the information sources at the end of this document.

2. **Olin College of Engineering and the ‘Olin Triangle’**

The Olin College of Engineering has quickly gained a reputation for being one of the most innovative institutions in the US since it opened in 1997. Through its partnerships with Babson and Wellesley colleges (the ‘Olin Triangle’), the college mandates that students combine science and engineering education with business and entrepreneurship, arts, humanities and social sciences. This gives students a holistic education and a broader outlook on the relationship between engineering and other disciplines.

Olin’s philosophy is that learning should be taken out of the world of academic theory and practiced in context. Tasks are designed to model real-life constraints such as finance and personnel, so that students learn the skills which are required to cope in a professional environment. All students complete a yearlong capstone project that gives them the opportunity to implement what has been learned in the non-academic world. The culture that has developed amongst the Olin staff promotes continual ‘tinkering’ and improvement of their teaching; their pioneering SEER summer program (see below) engages undergraduates with education research, so that the students can improve the overall education that Olin provides.

**SUMMER INSTITUTE**

The Olin Collaboratory Summer Institute has provided participants from around the country and around the world with the opportunity to conceive and catalyze change in engineering education. In 2018, Designing Student-Centered Learning Experiences was held June 4-8 on the Needham campus. **Dates for the 2019 Summer Institute will be announced in autumn 2018.**

Designing Student-Centered Learning Experiences is a week-long interactive workshop for faculty teams engaged in a curricular change effort at their own institution. Through participatory workshops, immersive design exercises, and presentations from experts, teams of faculty learn about, experience, and practice effective, engaging teaching approaches for new and meaningful STEM curricula. Through the Summer Institute experience, the institute aims to create a learning environment for participants that:

- Embraces creativity, prototyping, iterating, and ‘dreaming big’;
- Introduces a set of tools, concepts, and language about student-centered experience design;
• Promotes exploration of a participant’s own context in a new way and provides insight into what is done at Olin;
• Builds community among educators, change agents, designers, and learners.

Together with others from comparable institutions, you and your team develop concrete action plans for curricular change. Sessions are highly participatory and participants are challenged to continually consider new ideas and put novel approaches into practice. Institute attendees acquire a new lens through which to view their projects, an expanded repertoire of techniques and solutions, and concrete steps to take their plans forward.

Past attendees have ranged from Deans to new faculty members as well as everyone in between. All participants should be prepared to spend the full week deeply engaged in this demanding program. Applicants must apply in teams of at least three and describe a project (in the contemplation, planning, or execution stage) at their home institution. Teams are also required to do preliminary homework, such as interviewing students from their own institution; this work provides a background to the week’s activities.

The fee for the 2018 program was $10,000 for a team of up to three people, and $3000 per person for each additional team member. Applicants typically come to Summer Institute with some amount of institutional support for the project (whether financial or otherwise).

For sources of additional information consult the information sources at the end of this document.

3. Harvard Kennedy school, Ash Center for Democratic Governance and Innovation Field Lab

There is also an increasing trend of real-world, project-based work in the social sciences. In 2015, the Ash Center for Democratic Governance and Innovation at the Harvard Kennedy school founded the ‘Urban Innovation Field Lab’, a project aiming to improve social conditions in cities in Massachusetts. The Ash Center recognises that improving social conditions is a collaborative, multi-sector effort and has partnered with a group of five cities in Massachusetts. The resulting field lab embeds teams of graduate students to collaborate with local governments to develop a holistic, data-driven strategy to prioritize and resolve the prevalence of problem properties.

Using ‘problem-driven innovation’, students meet with stakeholders and officials from different municipal sectors and departments generate strategies to assist their local areas. The Lab doubles as a research centre and a teaching environment generating cutting edge research as well as giving students credits which count towards the completion of their degrees.

The Field Lab begins with a class (MLD-621) co-taught by Jorrit de Jong, (lecturer in public policy), and Joe Curtatone, (the current mayor of Somerville and Innovations in American Government Fellow at the Ash Center). Following the completion of MLD 621, students have the opportunity to then work in one of the Field Lab’s five partner cities across Massachusetts to help implement solutions to combat the scourge of problem properties.

The students undertaking this experience are provided with the opportunity to apply problem solving skills in a public setting, to be challenged to think in new and creative ways and to understand how to lead change. The project also provides an opportunity to investigate the effects of innovation on a particular area of urban policy, with potential implications for theories of public sector innovation.
For sources of additional information consult the information sources at the end of this document.

4. **MIT and Station1**

Station1 at MIT is implementing an idea proposed by Faculty member Christine Ortiz for a university with no classrooms or lectures. The resulting new model of higher education integrates three foundational principles - inquiry, impact, and inclusion.

**Inquiry: Learning at the Frontiers of Science and Technology**

Learning through inquiry, more specifically the process of research, whether in industrial internships, academic laboratories, or other organizations, is one of the most rigorous, effective and deepest forms of active, project-based learning and is at the core of the Station1 Model. Through the integration of disciplines, Station1 has developed a learning framework and blended (virtual and physical) methodology that ‘scaffolds, contextualizes, and enhances inquiry and research-based learning to enable students to create new knowledge, technologies, and processes for positive societal impact’.

**Inclusion: Promoting Equity Through Pedagogy**

At Station1, participation by students of diverse backgrounds is only a necessary first step. Station1 strives to create a learning environment where each student can ‘leverage their differences to reach their greatest potential and to achieve their academic, personal, and professional goals’. With an objective to go beyond inclusion and equality to equity, the latest pedagogical research on these topics is incorporated in the Station1 Model. Additionally, Station1 is embedding inclusion and equity throughout the project-based inquiry and research process itself, for example by modifying engineering design and the scientific method to be mindful of and promote equity in its outcomes.

**Impact: Societal Perspective and Impact**

Station1 is integrating frontier technological education with societal perspective and impact, using inquiry as the scaffold for this integration. From the selection of projects to the way they approach and integrate technological and humanistic concepts within the inquiry process itself, students are provided with a holistic framework for lifelong learning. The Station1 Model ‘aspires to be transdisciplinary and draws upon history, social studies of science and technology, equity, social innovation, and leadership development connected to emerging fields of science and technology’.

Self-directed learning, broader societal context, inclusion and equity, rigorous technological projects in emerging fields, and embedded 21st century skills are core integrated components of the Station1 Model and, hence, one of the most promising avenues to prepare students for lifelong learning and evolving careers in science and technology.

For sources of additional information consult the information sources at the end of this document.

5. **Monterrey University (Mexico): Tec21 Educational Model**

The Tecnologico de Monterrey (ITESM) in Mexico has launched the Tec21 CBL Educational Model. It is a flexible model in its curriculum that promotes student participation in challenging and interactive learning
experiences. At the undergraduate level, one of the central scopes of this model is addressing challenges by the student, to develop disciplinary and cross-disciplinary skills\textsuperscript{112}.

The Tec21 model is designed to expose students to situations of uncertainty and in some cases failure tolerance in order to develop their resilience. This is a concern for students in the colleges of engineering, as they are required to have the ability to think critically and solve problems as outlined in the Accreditation Board for Engineering and Technology Inc. (ABET) criteria. Besides the development of disciplinary skills, with this pedagogical approach student motivation toward learning, for their connection to the environment it is encouraged. At the same time, during the process of solving the challenge of innovation, collaboration and multidisciplinary work is encouraged.

Two institutional strategies have been implemented to reach the ultimate goal of the ITESM, to work in all careers under the CBL system: the innovation week (i-week) and the innovation semester (i-semester).

For sources of additional information consult the information sources at the end of this document.

Canada

1. University of Waterloo: Co-operative education model

In Canada, the University of Waterloo uses a model of co-operative education, where students’ time is split between study and assessed work experience. Its success has led it to spread to over 100 colleges and universities although the University of Waterloo’s program remains the largest post-secondary co-op program of its kind in the world. Students apply the knowledge they have learned in the classroom on paid work placements, where they also have the opportunity to secure job offers and gain valuable experience. As it is credited, students are required to engage in productive work rather than purely observational, and are assessed by their employers and on their own written reports. Currently over 60 per cent of the University’s 30,000 undergraduate students take part in the program, along with over 6,000 employers.

For sources of additional information consult the information sources at the end of this document.

\textsuperscript{112} See Membrillo-Hernández et al. 2018
Information sources consulted

Nesta 2016, The challenge-driven university: how real-life problems can fuel learning, Geoff Mulgan and Oscar Townsley

Available at: https://www.nesta.org.uk/blog/the-challenge-driven-university-how-real-life-problems-can-fuel-learning/

The MacMaster Model

- http://fhs.mcmaster.ca/
- https://mdprogram.mcmaster.ca/mcmaster-md-program/overview/pbl---problem-based-learning

Individual examples

New Mexico
- See http://fcm.unm.edu/education/physician-assistant-program/problem-based-learning.html

Taiwan
- See https://www.editlib.org/p/33845/.

Stanford University, School of Engineering: P5BL model
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Olin College of Engineering and Summer Institute
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Harvard Kennedy School, Ash Center for Democratic Governance and Innovation and Innovation Field Lab
- See: https://ash.harvard.edu/innovation-field-lab
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- Membrillo-Hernández et al. 2018 The Case of Sustainable Development Engineering at the Tecnologico de Monterrey, Mexico City Campus *IJEP No. 3 (2018)* Available online at https://doi.org/10.3991/ijep.v8i3.8007
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University of Waterloo: Co-operative education model
- See https://uwaterloo.ca/co-operative-education/about-co-operative-education
Aalto University/ Factories

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Nerland and Prøitz 2018 Pathways to quality in higher education Case studies of educational practices in eight courses Edited by Monika Nerland and Tine S. Prøitz Nordic Institute for Studies in Innovation, Research and Education (NIFU)


Maastricht University: PBL


Geneva Tsinghua Initiative (GTI)

- And http://ul4gg.org/

Centre for Research and Interdisciplinarity at the Sorbonne Paris

- See https://cri-paris.org/the-cri/.

Imperial College London UK

- Energy Futures Lab: See https://www.imperial.ac.uk/energy-futures-lab/
- Masters in Innovation Design Engineering See: https://www.rca.ac.uk/schools/school-of-design/innovation-design-engineering/

University of Lincoln: Student as Producer

- See https://www.lincoln.ac.uk/home/ and https://www.lincoln.ac.uk/home/studywithus/undergraduatetestudy/
- Lincoln School of Engineering/ Siemens Industrial Turbomachinery See: https://www.lincoln.ac.uk/home/engineering/

Warwick

- Developing research-based learning in the undergraduate curriculum, Selina Todd, Department of History, University of Warwick (un-dated) Available at https://warwick.ac.uk/services/ldc/resource/interactions/issues/issue27/todd/
- Research-Based Learning Project Case Studies of Good Practice at the University of Warwick https://warwick.ac.uk/services/ldc/resource/rbl/case/wbs2.pdf