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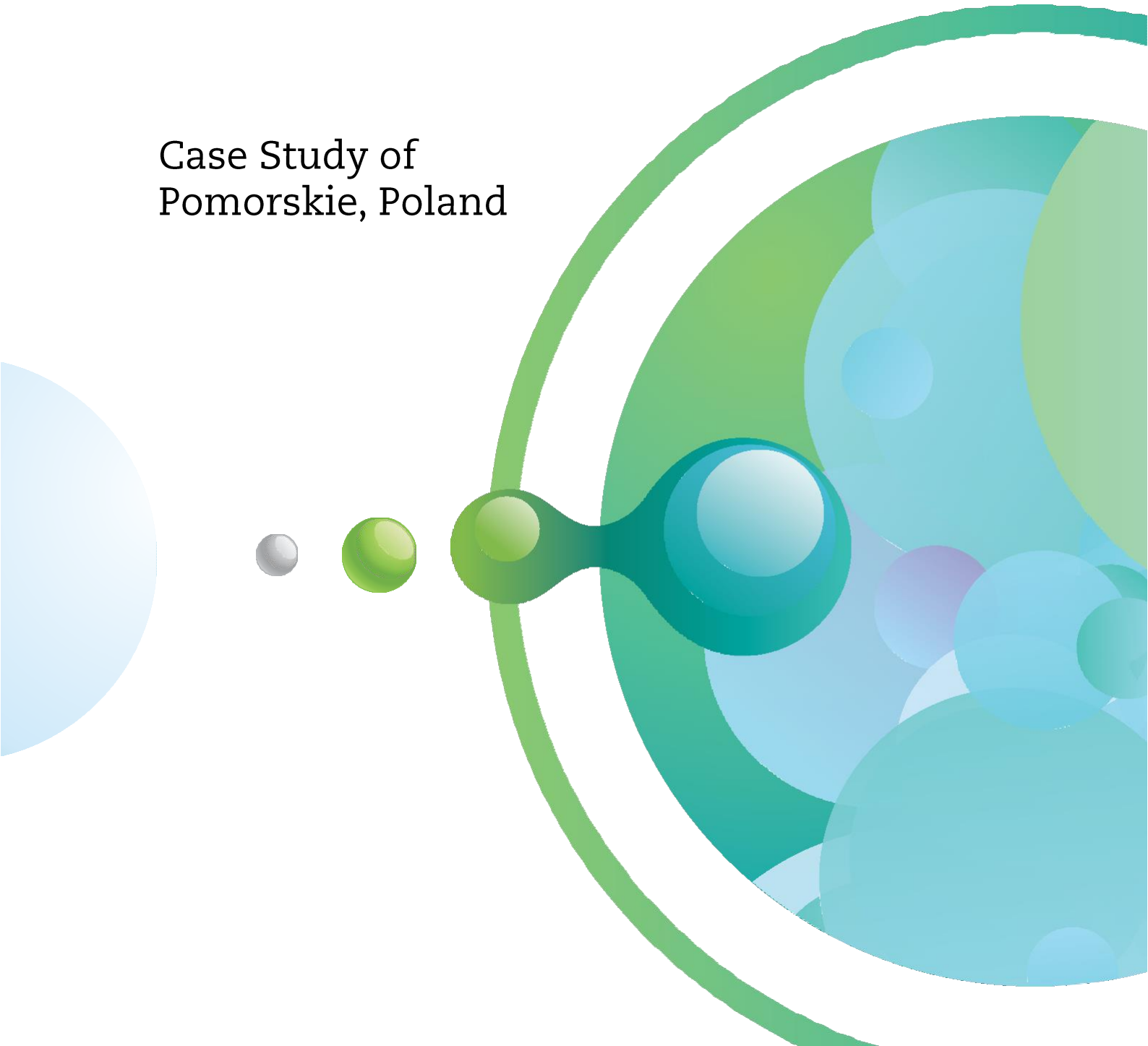
LOCAL ENTREPRENEURSHIP ECOSYSTEMS AND EMERGING INDUSTRIES

Case Study of
Pomorskie, Poland



Local Entrepreneurship Ecosystems and Emerging Industries

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July 2019

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This paper was authorised for publication by Lamia Kamal-Chaoui, Director, Centre for Entrepreneurship, SMEs, Regions and Cities, OECD.

Foreword

This case study examines the local entrepreneurship ecosystem of the Pomorskie region in Poland and its capacity to promote productivity upgrading and industrial renewal. It forms part of the work stream on local entrepreneurship ecosystems and emerging industries of the OECD's Local Economic and Employment Development (LEED) Committee.

The OECD local entrepreneurship ecosystems work examines the main dimensions of local entrepreneurship ecosystems that affect innovative start-ups, scale-ups and innovation in existing enterprises in case study regions. It relates the policy development of local entrepreneurship ecosystems to the principle of regional smart specialisation, and investigates how smart specialisation strategies are helping to strengthen entrepreneurship and innovation in regions.

Pomorskie is a very interesting case study region with high potential for entrepreneurship and innovation. It has key assets in a strong set of universities, research organisations, large enterprises, local clusters and start-up development infrastructure. Its regional government has an active policy for promoting entrepreneurship and emerging industries through its smart specialisation strategy.

This case study examines the Pomorskie local entrepreneurship ecosystem and regional smart specialisation approach. It identifies bottlenecks and enablers in the local entrepreneurship ecosystem and makes policy recommendations on how to further strengthen local entrepreneurship and industrial renewal. The case study offers a number of policy suggestions and models for Pomorskie and for other regions interested in promoting entrepreneurship and emerging industries.

Acknowledgements

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The project was led by Jonathan Potter, Head of the Entrepreneurship Policy and Analysis Unit, CFE, OECD, and Sandra Hannig, Policy Analyst, Entrepreneurship Policy and Analysis Unit, CFE, OECD. The case study was drafted by a team involving Tomasz Brodzicki (Institute for Development, Sopot, Poland), Chay Brooks (University of Sheffield, United Kingdom), Krystyna Gawlikowska-Hueckel (Institute for Development, Sopot, Poland), Sandra Hannig (OECD), Fumi Kitagawa (University of Edinburgh, United Kingdom), Max-Peter Menzel (University of Bayreuth, Germany), Jonathan Potter (OECD), Stanisław Umiński (Institute for Development, Sopot, Poland) and Tim Vorley (University of Sheffield, United Kingdom).

The project was co-ordinated in Poland by Przemysław Herman, European Social Fund Department, Ministry of Investment and Development, and Karolina Lipińska, Department of Economic Development, Office of the Marshal of the Pomorskie Voivodship.

Many individuals and organisations in the region provided important information. A wide range of stakeholders participated in meetings with the OECD review panel during an OECD study mission to the region and stakeholder workshop held on 2 October 2018 in Gdansk to discuss the case study. The participating organisations included political representatives of the Self-government of Pomorskie Voivodship, the Office of the Marshal of the Pomorskie Voivodship, Pomerania Development Agency Co., Gdansk Economic Development Agency Ltd (Invest GDA), Regional Chamber of Commerce of Pomorskie, Pomorskie Employers, “Free Entrepreneurship” Association, Pomorskie Development Fund Ltd., Pomorskie Loan Fund Ltd., Pomorskie Regional Credit Guarantee Fund Ltd., Black Pearls VC, Pomeranian Science and Technology Park, Gdansk Entrepreneurship Foundation (Starter Incubator), Economic Foundation (Gdynia Incubator of Entrepreneurship), Business Link (Academic Business Incubator), Gdansk University of Technology (Excento Ltd.), Medical University of Gdansk, University of Gdansk (Technology Transfer Office), Gdynia Maritime Academy, Sopot University of Applied Sciences, Gdansk Maritime Institute, Institute of Power Engineering of Polish Academy of Sciences, Institute of Fluid-Flow Machinery of the Polish Academy of Sciences, Baltic Eco-energy Cluster, Interizon Pomorskie ICT Cluster, Logistic and Transport North-South Cluster, Olivia Business Centre, Gdansk Global Foundation (O4 Coworking), InfoShare Foundation, Ship Design and Research Centre Co., Port of Gdansk Authority, Gdynia Port Authority Co., Remontowa Shipbuilding Co., Hydromega Ltd., Polpharma, Flextronics, Solwit, Airhelp, PolTREG, Blirt, TECH-ACC Ltd., ISS RFID Ltd., KERI Ltd., NNT Ltd., Antal.

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Acronyms and abbreviations

AEP	Academic Entrepreneurship Incubators
AI	Artificial intelligence
AIP	Academic Incubator Programme
AMOS	Autonomous Marine Operations and Systems
AR/VR	Augmented Reality and Virtual Reality
BPO	Business process outsourcing
BSR	Baltic Sea Region
CeSOS	Centre for Ships and Ocean Structures
CEE	Central and Eastern Europe
CEO	Chief executive officer
CIS	Community Innovation Survey
CoR	European Committee of the Regions
CPD	Continuing professional development
CSR	Corporate social responsibility
CTO	Ship Design and Research Centre Company
DKK	Danish Krone
EC	European Commission
EDP	Entrepreneurial Discovery Process
EEI	Entrepreneurial Ecosystem Index
EER	European Entrepreneurial Region
EIS	Enterprise Investment Scheme
EPO	European Patent Office
EQI	European Quality of Government Index
ERDF	European Regional Development Fund
EU	European Union
EUR	Euro
FDI	Foreign direct investment
GBP	British Pound

GDP	Gross domestic product
GPN	Global production network
GSTP	Gdansk Science and Technology Park
GUT	Gdansk University of Technology
GVA	Gross value added
GVC	Global value chain
H2020	Horizon 2020 (a programme of the EU)
HEI	Higher education institution
ICT	Information and communications technology
IDA	Industrial Development Authority, Ireland
IE OP	Innovative Economy Operational Programme (of the EU)
IiP	Invest in Pomerania
INTERREG	EU programme – helps develop better policy through inter-regional cooperation
IP	Intellectual property
IT	Information technology
LQ	Location quotient
MIT	Massachusetts Institute of Technology
MNE	Multinational enterprise
MUG	Medical University of Gdansk
NACE	Statistical Classification of Economic Activities in the European Community
NCRD	National Centre for Research and Development
NGO	Non-governmental organisation
NTNU	Norwegian University of Science and Technology
NUTS	Classification of Territorial Units for Statistics in the European Community
OECD	Organisation for Economic Co-operation and Development
PARP	Polish Agency for Enterprise Development
PE/VC	Private equity/venture capital
PhD	Doctor of philosophy
PLN	Polish Zloty
PPP	Purchasing power parity
PRO	Public research organisation
PSIK	Polish Private Equity and Venture Capital Association
PSS	Pomorskie Smart Specialisations

PSTP	Pomorskie Science and Technology Park
R&D	Research and development
RCA	Revealed comparative advantage
RCI	Regional Competitiveness Index (of European Commission)
RGP	Rural Growth Pilot
RII	Regional Innovation Index
RIS	Regional Innovation Scorecard
RIS3	Research and innovation strategy for smart specialisation
ROP	Regional Operational Programme (of the European Union)
S3	Smart specialisation strategies
SCF	Scottish Co-investment Fund
SMEs	Small and medium-sized enterprise
SSC	Shared service centres
SWOT	Strengths, weaknesses, opportunities, threats
TTO	Technology transfer office (of a university in general)
UG	University of Gdansk
USD	US Dollar
USSR	Union of Soviet Socialist Republics
VAT	Value Added Tax
VC	Venture capital
WP	Wirtualna Polska

Executive Summary

The Pomorskie region

Pomorskie has a population of approximately 2.3 million inhabitants, much of it concentrated in the metropolitan Tri-City area (Gdansk, Gdynia and Sopot). It has experienced relatively strong economic growth in recent years, associated with population growth and low unemployment. Its rate of new business creations and share of high-growth enterprises are above the Polish average, although the European Regional Innovation Scoreboard indicates that its innovation performance is still only "moderate" in comparison with all European Union regions.

The regional government has actively involved regional stakeholders in developing a regional smart specialisation strategy to help target and prioritise research and innovation policy. The strategy of Pomorskie focuses on four specialisations – offshore, port and logistic technologies (maritime); interactive technologies in an information-saturated environment (ICT); eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction (energy); and medical technologies in the area of civilisation- and ageing-associated diseases (medical technologies).

Innovative start-ups and scale-ups and innovation in existing enterprises will play a key role in the development of these smart specialisations.

Key findings

Networking, finance and skills support can boost innovative entrepreneurship

Innovative start-ups and scale-ups benefit from a range of entrepreneurship and innovation policies in Pomorskie together with a healthy entrepreneurship culture and strong research activities in the region's smart specialisations. However, networks need to be strengthened across businesses, universities and research organisations. Equity finance for start-ups and scale ups is also constrained, despite key policy initiatives such as the national Bridge Alpha Investment fund. Another bottleneck is a shortage of people with strong entrepreneurship skills (such as creativity, initiative, and problem solving) and digital skills.

Large enterprises can be more engaged in the local entrepreneurship ecosystem

Pomorskie has attracted 12 000 new jobs in inward foreign direct investment (FDI) since 2011 and hosts some important Polish-owned large firms such as Polpharma. Such firms commonly provide a major catalyst for innovation and entrepreneurship in innovative regions but this is not yet happening in Pomorskie for three reasons. First, the research and

development (R&D), skill and knowledge intensity of large firm activities in Pomorskie often remain below that which the region could support, although they are improving. Second, large firms in Pomorskie do not typically encourage their employees to create new ventures within or outside the firm. Third, the local operations of large firms are rarely adopting open innovation models involving inter-organisational collaborations, although there are some examples of this approach in the region.

Policy can help strengthen the Pomorskie Smart Specialisation

Maritime – This specialisation is developing largely through a 'related industrial diversification' pathway involving diversification from traditional shipbuilding into higher-value activities including specialised ships, yachts and wind farms. In this transition, local businesses are making use of established local skills and knowledge, strong local knowledge networks and strong local labour mobility within the specialisation. Logistics and transportation activities are also expanding. Further development can be promoted by greater adoption of digital technology opportunities, which can be supported by fostering better connections with the region's Information and Communications Technologies (ICT) sector and addressing local shortages in digital skills.

ICT – The development of this specialisation largely involves 'industry upgrading' through 'climbing global production networks'. This is occurring through ongoing upgrading of skills and production capabilities. Local strengths in the specialisation include a large number of major FDI affiliates in ICT, many recent ICT start-ups, specialist university departments contributing research and training and a pool of skilled employees and managers. The specialisation has potential to grow more quickly and support the regional economy more strongly through provision of specialist IT services to the other smart specialisations. In addition, more digital start-ups could be encouraged by addressing a bottleneck in access to risk capital for digital enterprises and increasing the involvement of large firms in the support of local business incubators hosting ICT enterprises.

Energy technologies – This specialisation is developing largely through a pathway of 'industry emergence' involving importation of new activities that have not traditionally been present in the region. Two key local anchor organisations are Energa (a major energy supply company with operations in the region) and the Institute of Power Engineering (a research institution). However, these organisations are largely involved in national functions and networks, and the specialisation lacks local knowledge networks and a critical mass of local SMEs and start-ups.

Medical technologies – This specialisation is largely following a path of 'industry upgrading' through 'renewal' involving importing new technologies, organisational innovations and new business models through external knowledge exchange connections. The Medical University of Gdansk (MUG) and local branches of Polpharma (a major Polish pharmaceuticals company) are the key anchor organisations in the region. However, while they have extensive national and international knowledge exchange networks, local knowledge networking is relatively weak. Furthermore, there are few local biotechnology start-ups compared with leading biotechnology regions.

Key recommendations

The case study offers a number of specific recommendations for policy in Pomorskie, including:

Develop innovative start-ups and scale-ups

- Introduce talent attraction initiatives in strategic areas such as ICT, which target Polish expatriates, international students and international managers with business expertise.
- Boost extra-curricular activities for entrepreneurship awareness and skills in universities and colleges.
- Strengthen local availability of equity finance and connect local firms to international venture capital funds.
- Incentivise managers in larger companies to become mentors for start-up entrepreneurs.

Engaging large enterprises in the local entrepreneurship ecosystem

- Develop and market detailed value propositions based on economic intelligence aimed at attracting higher value-added FDI to the region's smart specialisations.
- Increase local FDI aftercare services to encourage retention, expansion and upgrading of local investments and increase the innovation, entrepreneurship and supply linkages between local FDI affiliates and related new and small businesses, e.g. through regular meetings with regional government authorities, supporting events, and longer-term supplier development programmes.
- Increase the adaptation of local secondary, vocational and tertiary level training programmes to regional labour market demands through increasing the involvement of large firms in regional skills needs intelligence and skills development partnerships.

Path development of the smart specialisations

- Introduce policy initiatives to support local labour mobility within and across the smart specialisations including movements between small and large firms and between university and industry, using policy models such as Industrial PhDs and Knowledge Exchange Partnerships.
- Ensure that co-location spaces for entrepreneurship and innovation like science and technology parks and incubators host a diversity of actors alongside start-ups, such as university laboratories, professional service providers, research organisations, and existing SMEs and large enterprises.
- Create a cross-cutting smart specialisation consortium including research and business stakeholders that involves players from all the existing smart specialisations in order to increase cross-fertilisation. There is particular potential for increased collaborations between ICT and maritime specialisation stakeholders.

1. Overall assessment and recommendations

This section summarises the findings and recommendations of the case study. It examines the smart specialisation context in Pomorskie, enablers and bottlenecks in the local entrepreneurship ecosystem for innovative start-ups and scale-ups, the engagement of large firms in the local entrepreneurship ecosystem, and the path development of the region's smart specialisations. It includes policy recommendations to strengthen the local entrepreneurship ecosystem and the development of the smart specialisations.

1.1. The regional context for entrepreneurship and smart specialisation

Pomorskie is a growing economy

Pomorskie is home to approximately 2.3 million people. Much of its population is concentrated in the metropolitan Tri-City area, which comprises Gdansk (460 000 inhabitants), Gdynia (250 000 inhabitants) and Sopot (40 000 inhabitants). The population grew by around 150 000 people in the period from 2000 to 2016. Unemployment is low, at approximately 3.3%, and there are emerging labour shortages, particularly for skilled labour. At the same time, there are economic disparities within the region – unemployment is higher and incomes lower in the rural areas outside of the Tri-City area.

Start-up and small firm numbers are high

The rate of new business formation in Pomorskie exceeded the average for Poland in 2015. The region also has one of the highest rates of active enterprises employing at least 10 people per inhabitant in Poland. It has a growing number of high-tech start-up success stories, although the number of start-ups achieving substantial scale is limited.

Pomorskie has a large and growing stock of foreign direct investment

Pomorskie has been very successful in attracting foreign direct investment (FDI). The number of FDI affiliates in the region increased from 2 891 in 2000 to 4 910 in 2016. This large stock of firms integrated into global value chains (GVCs) offers a key potential lever for wider productivity upgrading in the region.

The region is classed as a "Moderate Innovator"

There were 249 units conducting R&D activity in Pomorskie in 2015, composed of 175 business units, 16 higher education institution (HEI) units and 40 scientific and R&D units. However, R&D expenditure represented only 1.05% of GDP in 2014. Furthermore, although indicators of the region's innovation performance often stand above the Polish average, Pomorskie is classed in the European Regional Innovation Scoreboard 2017 as only a "Moderate Innovator" – behind the "Strong Innovator" and "Innovation Leader" region categories in Europe.

There is a dual economy in exporting

Pomorskie has the highest ratio of exports to GDP of any Polish region (64.2% in 2015). Its exporting is particularly strong in the maritime industries – including shipbuilding. On the other hand, many small and medium-sized enterprises (SMEs) are inactive in exports or have only limited export engagement.

There are bottlenecks in the local entrepreneurship ecosystem related to networks and finance

This study has developed an Entrepreneurship Ecosystem Index to map Pomorskie strengths and weaknesses relative to other regions in Poland. It shows that although Pomorskie has a very strong entrepreneurship ecosystem overall compared to other Polish regions, it has relative weaknesses on the dimensions of networks for entrepreneurship and availability of finance. The greatest ecosystem strengths of Pomorskie compared with other Polish regions are in the dimensions of entrepreneurship culture and new knowledge.

Pomorskie has several possible focuses for smart specialisation

Pomorskie has a diversified economy. This offers several possible focuses for smart specialisation policies, which aim at prioritising regional research and innovation investments on areas of distinct regional advantages and growth potential. Pomorskie has a growing knowledge-intensive services sector focused on ICT and including substantial business process outsourcing (BPO) and shared service centres (SSC) activity, driven in particular by inward FDI. It also has major long-standing maritime specialisations in shipbuilding and transport, shipping and logistics. Further sector strengths in the region include renewable energy, biotechnology, food, the silver economy, tourism, and the automotive industry.

The region has prioritised four smart specialisations

The European Union has made it an "ex ante conditionality" of European Regional Development Fund (ERDF) research and innovation funding that a smart specialisation strategy (S3) must be developed – at the level of regions or Member States – as a guide to prioritisation of investment. The Pomorskie regional government has developed an S3 at regional level focused on promoting cross-sectional technologies and potential products in four areas, namely:

1. Offshore, port and logistic technologies.
2. Interactive technologies in an information-saturated environment.
3. Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction.
4. Medical technologies in the area of civilisation- and ageing-associated diseases.

Smart specialisations 1 (maritime) and 2 (ICT) reflect the largest existing business and research concentrations in the region. The existing scale of activity to build on is smaller in the case of smart specialisations 3 (energy technologies) and 4 (medical technologies). The ICT specialisation has strong scope for supporting the other specialisations in the region, for example in helping them to integrate opportunities in artificial intelligence and machine learning.

The region used an Entrepreneurial Discovery Process (EDP) to develop the S3

The European Commission offers guidance on the process that regions could use to develop S3 (see http://s3platform.jrc.ec.europa.eu/), which stresses stakeholder engagement through an "Entrepreneurial Discovery Process (EDP)". The regional government of Pomorskie has actively engaged stakeholders in an EDP when developing, updating and implementing its S3.

In addition to undertaking an economic and industry analysis of the region, the regional government invited stakeholders from regional research and industry to group together to propose smart specialisation partnerships for joint or related research or innovation actions. Existing cluster organisations in the region, which had been established in a prior round of EU funding programmes, were among the stakeholders given their key potential role as focal points for collaboration. The proposals from research and industry were each taken as potential smart specialisation areas for the regional strategy.

Seven of the partnership proposals were selected for a full evaluation by technical experts. The evaluation was based on global trends, market potential, economic and technological

potential, a domestic and international benchmarking, the proposed strategy and action plan, and the potential of the partnership. The seven proposals were then narrowed down by the experts and regional government to the four smart specialisations discussed above.

1.2. Stimulating innovative start-ups and scale-ups

Regional support for entrepreneurship and business innovation is well developed

There is a good supply of support services for business innovation. In particular, science and technology parks (in Gdansk and Gdynia), incubators (e.g. STARTER, Gdynia Innovation Centre and Gdynia Business Incubator), and accelerators (e.g. the Constructors' Park and Space3ac) offer a range of co-location spaces, advice and mentoring services and support for research projects and services.

The networks of entrepreneurs are uneven across smart specialisations

Local networks among entrepreneurs and between entrepreneurs and HEIs and large firms are already fairly strong in the ICT sector. They are facilitated by the strong local presence of ICT FDI, which helps local start-ups and scale-ups to access global ICT value chains, and by policy initiatives for networking such as Interizon and infoShare Academy. However, the networks of entrepreneurs are not so strong in medical technologies and energy technologies, which limits potential sources of knowledge for start-ups and scale-ups about markets, technology, academic research, available skilled labour, product and service suppliers, finance and so on.

The region's cluster organisations have been an effective force in facilitating the creation of research partnerships involving firms and HEIs during the initial process of establishing the smart specialisations, despite their limited funding. More systematic calls could be made to the cluster organisations to broker collaborations in a range of areas, including skills and training, support for entrepreneurship and corporate venturing, and collaborative research.

Availability of equity financing is still limited

Access to credit for entrepreneurs is supported by various public initiatives in Pomorskie, including the Pomorskie Loan Fund, the Pomorskie Regional Loan Guarantee Fund, and the Pomorskie Development Fund. However, there is a shortage of private equity funding, despite instruments such as the national Bridge Alfa Investment programme. There are emerging inter-regional business networks in the Baltic Sea Region (BSR) and Central and Eastern Europe (CEE) that could help connect entrepreneurs with potential equity investors, but they are not yet promoted sufficiently to local start-ups and scale-ups.

Entrepreneurship and digital skills need to be strengthened and talent attracted

Despite a number of existing initiatives, such as entrepreneurship courses and academic incubators in HEIs, entrepreneurship education is under-developed in schools, vocational education colleges and HEIs in Pomorskie. This affects the supply of individuals with strong competences for start-ups and scale-ups (opportunity recognition, taking initiative, acting as problem solvers, marshalling resources, mastering financial and technical knowledge etc.).

The region is also suffering from shortages of highly-skilled ICT workers. Policy initiatives to encouraged greater immigration by skilled workers could play a part in addressing the shortages, particularly by targeting the Polish diaspora abroad, international students, technology talents, and international managers who may be interested in developing entrepreneurial projects locally. At the same time, digital skills need to be expanded more broadly in the workforce to support SME innovation.

Academic entrepreneurship and knowledge exchange initiatives can be reinforced

The national Foundation of Academic Incubators of Entrepreneurship supports incubators at Gdansk University of Technology and the University of Gdansk, offering basic start-up services to students and staff. However, other HEIs in the region do not offer the same support. Greater flexibility in the local management of European Structural and Investment Funds would allow HEIs in the region to fund their own entrepreneurship support activities.

A further issue is that engagement with industry is still insufficiently valued in academic culture in Poland, despite certain islands of engagement. Greater incentives are needed for HEI staff and HEIs as institutions to support entrepreneurship and knowledge exchange.

The link between the S3 and entrepreneurship policy actions should be made clearer

The research priorities and plans for Pomorskie are set out in the S3 for the region in terms of four smart specialisations. However, the nature of policy actions to stimulate innovative start-ups and scale-ups in the smart specialisations and the sources of the resources for these actions are not made clear in the S3 although they are critical for the success of the development of the smart specialisations in the region. For example, mentoring can be a key tool for supporting the ambition and success of start-ups and scale-ups in the smart specialisations but an expanded pool of mentors is required together with support to mentors and entrepreneurs in establishing and operating mentoring relationships. Targeted public procurement initiatives could also be developed by the regional government to promote innovation in the smart specialisations where the smart specialisations correspond to a regional government input need.

Box 1.1. Recommendations on stimulating innovative start-ups and scale-ups

Access to finance

1. Consider the establishment of a regional equity investment fund.
2. Better connect innovative start-ups and scale-ups with venture capital and private equity networks internationally, including in Central and Eastern Europe and the Baltic Sea Region.
3. Encourage and support start-ups and scale-ups to participate in technology conferences that offer networking opportunities for financing.

Skills and talent

1. Develop talent attraction initiatives aimed at attracting potential entrepreneurs and highly-skilled labour, including ICT, particularly in the smart specialisations. These initiatives can target Polish expatriates, international students and international managers with business expertise and leverage the presence of existing international entrepreneurs and their networks.
2. Offer more entrepreneurship skills development activities in formal education and continuing professional development, such as short entrepreneurship courses and business plan competitions.
3. Improve the local mentor infrastructure by incentivising managers in large companies to become mentors for potential and existing start-up and scale-up businesses.
4. Increase the local supply of training courses for ICT specialists as well as on-the-job digital skills training for non-specialists.

Innovation and knowledge exchange

1. Improve incentives for businesses to make use of academic research and strengthen initiatives to promote knowledge exchange between universities and businesses.
2. Use local procurement to stimulate demand for innovative start-ups and scale-ups in the smart specialisations.

1.3. Engaging large enterprises in the local entrepreneurship ecosystem

The skills and knowledge content of FDI needs to be upgraded

Pomorskie has been very successful in attracting FDI in recent years. Since 2011, it has attracted some 80 FDI projects with 12 000 associated jobs. It also hosts several important operations of major Polish-based firms such as Polpharma in the medical technologies specialisation. The innovation, skills and value added content of these large firm operations has been increasing steadily and such firms often play important roles in innovation networks and skills development. However, although the quality of FDI in the region has been gradually increasing, inward investors continue to see low labour costs as an important reason for locating in Pomorskie, and the skills and knowledge content of FDI activity in the region is below the level that the skills and knowledge assets of the region could support. For example, workers with high-level skills from universities often work in roles

requiring lower skills among FDI affiliates in the business process outsourcing (BPO) and shared services centres (SSC) sectors in the region.

Some companies – notably Intel, Thomson Reuters, and Bayer – have acted as regional leaders in upskilling their existing workforces, moving employees from "back office" functions to more strategically important areas of activity creating greater value. More large firms operating in the region could follow this approach. Policy can also encourage large firms to increase their generation of new skills by supporting them to develop joint training programmes with educational institutions and by offering support for on-the-job training in large firms.

At the same time, there is a need to increase the stress of the marketing approach of Invest in Pomerania on attracting FDI with a greater innovation and skills content and greater efforts by Invest in Pomerania to embed them in local innovation, skills and entrepreneurship collaborations. This implies on marketing value propositions emphasising available research assets and skills profiles in the region's smart specialisations to potential inward investors. At the same time it suggests a need to increase the aftercare contacts of Invest in Pomerania with established inward investors in the region to understand their growth challenges and to offer the necessary services and incentives to encourage them to develop further and upgrade in the region and to build their local linkages.

There are many cases of large firm-HEI collaborations in the region

There are a number of examples of collaborations between large firms and HEIs in the region in the area of skills development that can be extended to other HEIs and vocational education and training colleges. For example, Sopot University of Applied Sciences and the Employment Office in Gdansk have developed a programme that trains junior accountants for large local firms including Arla Global Shared Services, Swarovski Global Business Services, Thyssenkrupp Group Services, and Bayer. In addition, Polpharma launched a new two-year master's degree at the Faculty of Pharmacy of the Medical University of Gdansk in 2017, helping supply scientists both to the firm and the regional economy more generally.

Large firms have untapped potential for corporate entrepreneurship

Large firms in innovative economies are increasingly encouraging corporate entrepreneurship, whereby employees create new ventures within or outside the company or make some important entrepreneurial transformation for the firm. There is so far relatively little evidence of large firms adopting a culture of corporate entrepreneurship in Pomorskie. This may come, however, with further upgrading of the innovation and skills content of local FDI activity. At the same time, the regional government could promote and showcase some existing examples of corporate entrepreneurship in the region to help build this culture among local employees and seek to involve large firms in supporting start-up initiatives and business incubators.

Open innovation approaches are not yet widespread in the region's large firms

A number of the region's large firms have developed very productive innovation linkages with regional HEIs. For example, a collaboration between Polpharma and the Medical University of Gdansk has included the development of new interdisciplinary scientific projects through the Polpharma Development Centre. There are also some important examples of large firms in the region engaging with start-ups in innovation relevant to their

firms, such as the start-up accelerators run by Lotos and Energa. However, the examples of large firm collaboration with HEIs, start-ups and SMEs are not widespread.

This reflects a slowness of many of the region's large firm operations to adopt open innovation models, i.e. innovation approaches stressing the importance of collaborating with other firms and organisations through a principle of co-creation and co-development.

Policy can support the adoption of open innovation processes by large firms and greater engagement with local HEIs, SMEs and entrepreneurs by creating innovation centres to experiment in developing innovations in the areas in which local large firms are seeking to innovate. For example, in the ICT smart specialisation, innovation support could be provided to SMEs in the development of digital technologies, human artificial intelligence interfaces, and other future technological developments. Relevant large firms should be encouraged to take active roles in shaping the form of these innovation funding streams and innovation centres.

Box 1.2. Recommendations for engaging large firms in the local entrepreneurship ecosystem

Upgrading and embedding large foreign and domestic firm activities

1. Research detailed value propositions to attract high value-added inward FDI projects in the smart specialisation fields, indicating local assets and resource availability. Take initiatives to increase research, innovation, skills and entrepreneurship in these fields so as to boost the value propositions.
2. Strengthen aftercare support to FDI (such as regular one-to-one meetings with investors) to understand how to support FDI to reinvest and develop in the region.
3. Encourage large enterprises in the region to increase the generation of higher-level skills by strengthening their involvement in skills development initiatives involving secondary, vocational and tertiary educational institutions and supporting on-the-job training within large companies.

Creating a culture of open innovation

1. Increase understanding of the methods and benefits of open innovation processes among local stakeholders (SMEs, HEIs and research organisations, and large firms).
2. Support large firm open innovation platforms in the region by funding related innovation projects by potential partners, including SMEs, and establishing related innovation centres. Encourage local large firms to take active roles in shaping the form of these innovation funding streams and innovation centres.
3. Increase local awareness of corporate entrepreneurship processes and their benefits for large firms, and offer support to large firms facilitating corporate spin-outs.

1.4. Knowledge exchange and path development of the smart specialisations

The maritime smart specialisation is developing through 'related diversification'

The maritime smart specialisation in Pomorskie (i.e. offshore, port and logistic technologies) is developing through an industrial transition pathway based on related

diversification[1], building on the competencies and knowledge of established industries in the region.

Gradual decline in traditional shipbuilding is being mitigated by growth of new production areas related to the region's traditional shipbuilding strengths, including specialised ships and yachts and wind farms. In addition, new port-related logistics and transportation activities are developing, which, if developed further, could position Pomorskie as a logistic hub for the BSR.

A key strength of this smart specialisation in Pomorskie is its established extensive and deep knowledge networks. The smart specialisation has extensive and long-established regional inter-firm relationships and research connections, and good connections to other sectors and foreign partners. A further key strength is a high level of skills in the specialisation, which supports knowledge absorption and entrepreneurship. High labour mobility is also supporting knowledge exchange and entrepreneurship, as workers who lost jobs in traditional shipbuilding have moved into new activities both within the sector and in other sectors, helping apply their knowledge in new contexts and building connections across firms and organisations.

The future success of the smart specialisation will depend greatly on integrating digital competences, for example for the digitalisation of harbour logistics. A deliberate strategy should therefore be developed to build connections between the maritime and ICT smart specialisations within the region.

The ICT smart specialisation is developing through 'industry upgrading through climbing global production networks'

The ICT smart specialisation (interactive technologies in an information-saturated environment) in Pomorskie is following an industrial transition pathway driven by 'industry upgrading', mainly involving 'climbing global production networks'. Thus it is involved in a process of moving up the value chain based on upgrading of skills and production capabilities.

The smart specialisation includes branches of several multinational companies such as Intel, Amazon, and Thomson Reuters. It also includes some spin-outs from multinationals (e.g. Solwit from Intel) and several successful local start-ups.

Key enablers of its transition are substantial inward FDI in BPO and SSC activities, strong ICT competences in universities, in particular the Gdansk University of Technology, and well-developed business support programmes for start-ups. The smart specialisation also benefits from strong knowledge networks supported by connections within the local pool of former employees of Wirtualna Polska (WP) (a local internet company start-up now operating in Warsaw), the integration of the local multinational enterprise subsidiaries within their parent companies and links to Polish expatriates in globally active ICT firms.

A bottleneck for the smart specialisation itself and for its contribution to strengthening the regional economy as a whole is weak connections to other smart specialisations in the region, despite some examples of cross-sector collaborations, such as linkages involving the Medical University of Gdansk and the Gdansk University of Technology on ICT and

[1] Annex B provides information on the framework used in the OECD local entrepreneurship ecosystems and emerging industries project to identify different potential industry path development opportunities for regions.

health. In order to build cross-sector linkages, efforts should be made to involve multinational subsidiaries as anchor firms in innovation projects that connect a variety of actors and pursue the incubator approach pioneered by O4, which is connecting a variety of start-up actors across sectors.

In addition, a missing link to external venture capital firms needs to be addressed for ICT start-ups and scale-ups.

The energy technologies smart specialisation is developing through 'industry emergence'

The energy smart specialisation (i.e. 'eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuels, and in construction') in Pomorskie is developing through a regional industrial transition pathway based on 'industry emergence', mainly through 'importation of new activities that have not traditionally been present in the region'.

Key regional players in the smart specialisation are Energa in the company sector and the Institute of Power Engineering research institute. These are major players, which have a long history in the region, but which also face the challenge of transition from fossil towards renewable energies.

Bottlenecks to the development of the smart specialisation are a lack of critical mass outside of the key anchors, including limited numbers of SMEs and start-ups, knowledge networks which are more national than regional in scope, and a dependence on state policy decisions to drive forward the transition to renewable energies.

The medical technologies smart specialisation is developing through 'industry upgrading through renewal'

The medical technologies (medical technologies in the area of civilisation- and ageing-associated diseases) smart specialisation in Pomorskie can be seen as largely following a path of 'industry upgrading' through 'renewal' of existing activities, i.e. shifting into a new direction based on importing new technologies, organisational innovations or new business models through external knowledge exchange connections. There are nevertheless also opportunities for related and unrelated industrial diversification in the smart specialisation. There is a variety of organisations of different scale in the smart specialisation, including the leading domestic large firm, Polpharma, the Medical University of Gdansk (MUG), and some spin-off enterprises from the MUG.

A key enabler of knowledge exchange in the smart specialisation is the external knowledge connections of many of the large operators. For example Polpharma has extensive globally-oriented operations and the MUG has extensive international connections with Pfizer. These external knowledge connections could be usefully complemented with more knowledge connections within the region. Policy could support the development of such connections by initiatives for labour mobility across the regional actors in the smart specialisation, for example incentives for PhD students and doctoral researchers to combine work in companies with research at universities. In addition, there have been several spin-off enterprises generated by the MUG. These firms maintain relations with the university and other firms. Establishing supporting organisations around these first movers could enhance knowledge exchange between university and industry in the region.

Nevertheless, compared with leading biotechnology regions, there are relatively few innovative start-ups in the smart specialisation. Polpharma's commitment to collaborate

with start-up firms in new technological innovations is therefore important. In addition, regulatory and cultural barriers to entrepreneurship in the universities need to be addressed both at national higher education system and individual university strategy level in order to support the emergence of more innovative start-ups.

A number of key overall conditions can be strengthened to support the smart specialisations

One of the critical issues for developing all of the smart specialisations is to increase knowledge networks and collective actions. The role of "social broker" and "multiple insider" is particularly important in animating networks working as hubs at the centre. This role can be played by organisations or individuals. The existing cluster organisations have an important potential role to play in this respect and further efforts are needed to support the clusters and their leaders in taking initiatives where relevant to the smart specialisations. Labour market mobility, including between HEIs and industry, and co-location of actors in science and technology parks, incubators and co-working spaces are also key processes in knowledge exchange that can promoted by policy.

Finally as well as developing connections within the smart specialisations, it is also important to develop cross-fertilisation among them, in particular between the maritime and ICT specialisations. A cross-specialisation working group could help with this, working alongside the existing working groups for each specialisation.

Box 1.3. Recommendations for further development of the smart specialisations

Overall recommendations

1. Enhance labour mobility between small and large firms as well as between university and industry in the smart specialisations. This can be achieved through the development of knowledge exchange partnerships, for example with industry-financed PhDs or exchange between academic and industry personnel.
2. Maintain the current co-location spaces like science and technology parks and incubators and ensure that they host a diversity of actors, such as university laboratories, professional service providers, research organisations, SMEs, and larger firms as well as young start-ups.
3. A cross-cutting consortium combining smart specialisation areas could be established to support cross-fertilisation across the smart specialisations.
4. Provide further support to the existing cluster organisations and cluster leaders relevant to the smart specialisations in order to act as "social brokers" facilitating networking and collective action among start-up and scale-up entrepreneurs, between larger and smaller companies, and between enterprises and universities.

Offshore, Port and Logistics

5. Promote modernisation by digitalisation. Encourage digitalisation by strengthening knowledge networks with other regions in ICT fields and increasing connections between the maritime and ICT smart specialisations within the region.

Interactive technologies in an information-saturated environment

6. Increase the interactions among players within the smart specialisation – including large firms, SMEs, start-ups, and HEIs – encouraging local large firms and incubators to become network hubs.

Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction

7. Support related diversification towards renewable energies and increase mass in the specialisation by promoting entrepreneurship in this field, particularly where it shares competencies with the region's other smart specialisations.
8. Facilitate the supply of risk capital to innovative ICT start-ups.

Medical technologies in the area of civilisation- and ageing-associated diseases

9. Stimulate greater connections between basic and applied research in the smart specialisation by supporting research projects and PhDs undertaken in companies, and supporting collective actions and networks around existing 'first mover' spin-offs in this specialisation in region.
10. Supporting the development of university spin-off enterprises with finance, advice, mentoring and other relevant support.
11. Increase incentives for academics to commercialise their research both at the level of the national higher education system and at the level of individual HEIs.

2. The Pomorskie regional economy and smart specialisation approach

This section presents information on the regional economy of Pomorskie, including population, productivity, entrepreneurship, innovation, exports and industry portfolio. It also examines key characteristics of the local entrepreneurship ecosystem. Finally, it discusses the content of the region's smart specialisation strategy and how the strategy was developed.

2.1. Regional economy overview

Population

The population of Pomorskie is approximately 2.3 million, corresponding to 6.0% of the population of Poland. The region's population density of 126 persons per km^2 is close to the national average (123 persons per km^2). Nearly two-thirds of the inhabitants live in urban areas, which are concentrated in the north-eastern area of the region, mostly in the metropolitan Tri-City area, which is focused on the cities of Gdansk (462 000 inhabitants), Gdynia (247 000 inhabitants) and Sopot (40 000 inhabitants).

The population of Pomorskie has increased from 2.17 million in 2000 to 2.31 million in 2016, with the growth concentrated in the rural areas of the region. Processes of population ageing are evidence in the region. Between 2000 and 2015 the number of people of pre-working age decreased by 19%, the number of people of working-age increased by 7.7% and the number of people of post-working age increased by 48.8%. Pomorskie has been experiencing positive net domestic and international migration, with a net migration ratio of 1.5 per 1000 population in 2015.

Unemployment

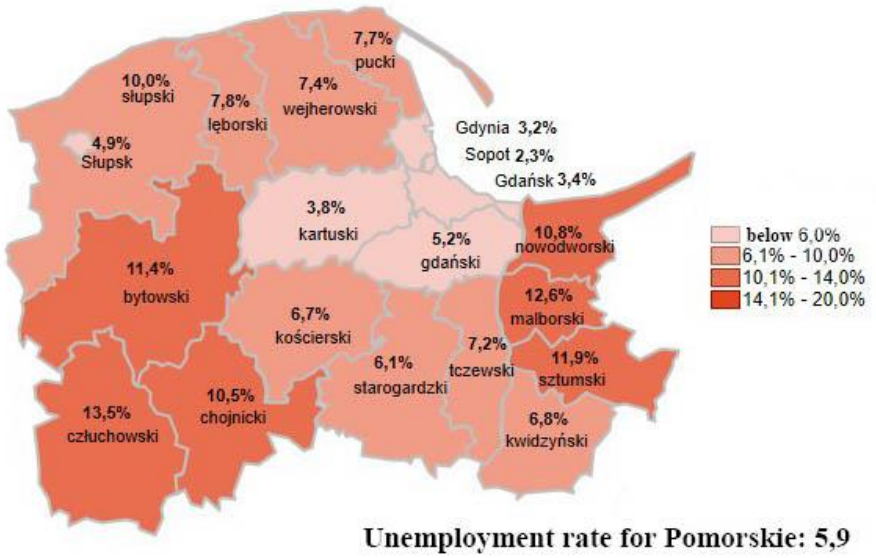
Pomorskie has been experiencing positive labour market trends in recent years driven in particular by business investments in services. Between 2012 and 2016, the number of unemployed people decreased by 50 000. Figure 2.1 shows unemployment trends from 2004 to 2017. At the same time, employers in several sectors report labour shortages. As a consequence, the number of job offers for foreign workers (mostly from Ukraine) has been growing, and the regional labour office reported that local employers declared 67 000 job offers for foreigners in 2016. Between 2014 and 2016, the declared demand for hiring workers from former USSR countries increased 12 times[2]. However, the unemployment rate varies substantially across counties in the region (Figure 2.2).

[2] Wojewódzki Urząd Pracy w Gdańsku (2016). *Rynek pracy województwa pomorskiego 2016. Informacja roczna*, Gdansk: WUG.

Figure 2.1. Trends in the number of unemployed people and unemployment rate, 2004-17

Source: Voivodeship Labour Office in Gdansk and own calculations based on Central Statistical Office data.

Figure 2.2. Regional differences of the unemployment rate in Pomorskie, end July 2017



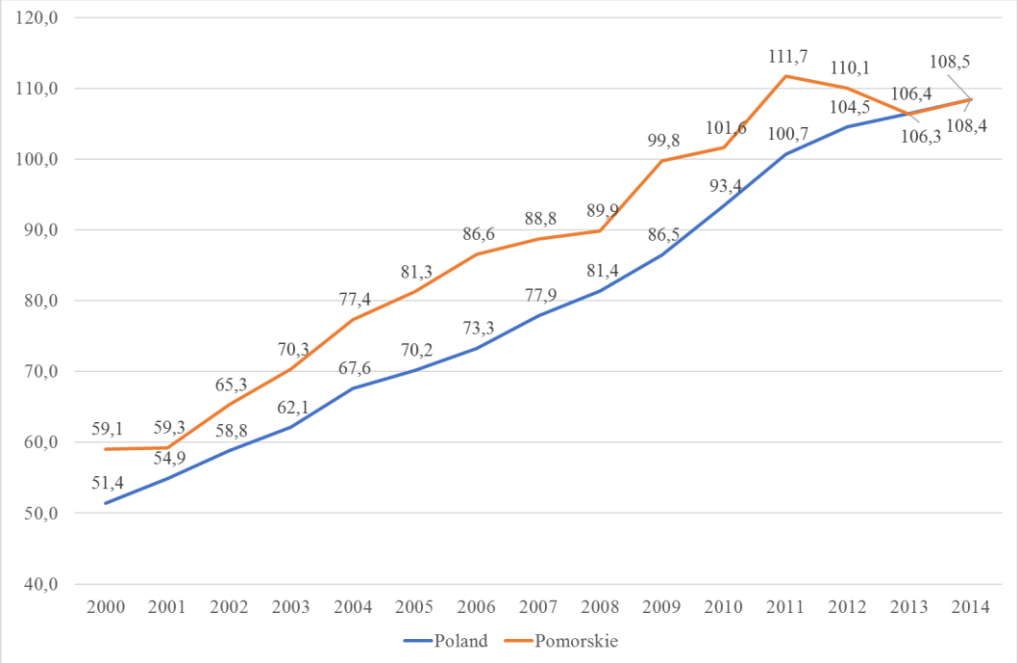
Source: Voivodeship Labour Office in Gdansk and own calculations based on Central Statistical Office data.

Productivity

Figure 2.3 shows labour productivity trends in the region. Labour productivity in 2014 was in line with that of Poland as a whole, although from 2000 to 2012, labour productivity for Pomorskie had been higher than the Polish average. The reason for the shift is not clear –

it might be a question of methodological issues or stem from growth in the services sector, where productivity levels tend to be below manufacturing.

Figure 2.3. GDP per employed person (current prices, thousand PLN)



Source: Author's calculations based on Central Statistical Office data from the Bank of Local Data.

Entrepreneurship

There were an estimated 159 100 active enterprises in the region in 2015 and 202 000 self-employed people. Pomorskie had a higher number of enterprises per 1 000 population (69.0) than Poland as a whole (61.3) in 2015. Similarly, the number of active enterprises employing 10 people or more per 1 000 inhabitants in Pomorskie was 1.40, compared with 1.34 in Poland as a whole in 2015. The rate of enterprise births in Pomorskie was 13.2% in 2015 compared with 12.0% in Poland, and the region's business birth and death numbers per 1 000 population were both higher than the Polish average. All these indicators point to relatively healthy entrepreneurship activity.

According to the Central Statistical Office[3], there were 259 high-growth enterprises in Pomorskie in 2015 (6.9% of Poland's total).[4] They employed 30 000 people and 25% of their revenues were accounted for by exports. However, in terms of average revenues per high-growth enterprise, the region occupies only 10th position in Poland. Most of the high-growth enterprises in Pomorskie operate in industry (code 87), trade, repairs of motor vehicles (code 55) and construction (code 38).

The region has also attracted substantial FDI – the number of foreign owned business operations in Pomorskie increased from 2 891 in 2000 to 4 910 in 2016.

[3] Central Statistical Office, (2017), *Selected entrepreneurship indicators in 2011-2015*, Warszawa.

[4] High-growth enterprises are defined as those (during a three-year period) reporting average growth of revenues by at least 20%.

Innovation

Pomorskie performs slightly better than the Polish average on several R&D intensity indicators. Thus, in 2014, the share of R&D expenditures in GDP in Pomorskie was 1.05% compared with 0.94% for Poland as a whole. Similarly, in 2015, R&D expenditures per employee were PLN 123 000 for Pomorskie compared with PLN 114 000 in Poland as a whole.

Furthermore, there has been a positive dynamic in regional innovation trends in Pomorskie. Thus employment in R&D activity in Pomorskie grew from 5 900 in 2013 to 6 900 in 2015, in line with the average for Poland. There were 249 units conducting R&D activity in Pomorskie in 2015, an increase from 183 in 2013. Some 175 were business entities, 16 were HEI entities and 40 were scientific and R&D units. Business units accounted for 50% of the value of expenditures on R&D in Pomorskie in 2015, while 12.7% of overall R&D expenditures were funded from foreign financial sources.

However, Pomorskie is classified by the European Union Regional Innovation Scoreboard 2017 as only a "Moderate Innovator" based on a comparison of 220 European regions on a range of innovation indicators below the "Innovation Leader" and "Strong Innovators" regions. Strengthening business R&D activity will be critical to improving this performance. As shown in Table 2.1, the innovation performance of enterprises in Pomorskie lags slightly behind the innovation performance of enterprises in Poland as a whole. A positive sign is given by an increase in the share of applied R&D in Pomorskie from 48% to 61% of R&D expenditures in the period 2013-15, and from 80% to 86% in the business sector.

Table 2.1. Innovation performance of industrial enterprises in Pomorskie and Poland, 2013-15

Percentage of total number of enterprises

	Pomorskie	Poland
Enterprises that introduced process or product innovations in 2013-15	15.6	17.6
new or significantly improved products	10.7	11.8
of which are new to the market	6.4	6.5
new or significantly improved processes	10.3	13.0
Share of enterprises that reported expenditures on innovation activity	12.7	14.0
Share of enterprises that reported established co-operation arrangements with other units of innovation activity in 2013-15	4.3	5.5

Source: Statistical Office in Gdansk (2017). Innovation activity in Pomorskie Voivodeship in the years 2013-2015, Gdansk.

Industry portfolio

Table 2.4 illustrates the industrial portfolio of Pomorskie, showing the 2-digit NACE rev. 1.1 sectors in the region with a relative employment specialisation compared with the national average, i.e. with location quotients (LQ) above 1. Values of LQ at or above 1.25 indicate strong regional specialisation.

The two highest LQs are in fishing, fish farming and related service activities and building and repairing of ships and boats. This points to the existing importance of the maritime

smart specialisation, especially when adding sea and coastal water transport and cargo handling and storage activities in the region (mainly in or around seaports).

In addition, there is a high LQ for manufacturing of electronic components and an above average concentration in hardware consultancy. Both point to the significance of the ICT sector, which is present mainly in the Tri-City area, Tczew and Kwidzyn.

Table 2.2. Regional location quotients for employment in Pomorskie (two-digit NACE rev. 1.1 codes) for sectors with LQ exceeding 1

NACE Sector	Name	LQ
5	Fishing, fish farming and related service activities	7.340
35	Building and repairing of ships and boats	6.885
61	Sea and coastal water transport	2.987
32	Manufacture of electronic valves and tubes and other electronic components	2.384
23	Manufacture of coke oven products	2.118
63	Cargo handling and storage	2.003
40	Production and distribution of electricity	1.636
21	Manufacture of pulp, paper and paperboard	1.495
20	Sawmilling and planing of wood; impregnation of wood	1.393
41	Collection, purification and distribution of water	1.352
55	Hotels	1.342
28	Manufacture of structural metal products	1.341
36	Manufacture of furniture	1.276
2	Wood production	1.249
67	Activities auxiliary to financial intermediation, except insurance and pension funding	1.236
70	Real estate activities with own property	1.173
19	Tanning and dressing of leather	1.145
71	Renting of automobiles	1.101
45	Site preparation	1.088
72	Hardware consultancy	1.074
80	Primary education	1.038
74	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings	1.019
85	Human health activities	1.000

Source: Own calculations based on unpublished CSO data.

Pomorskie is also characterised by a relatively high level of "clustering" in the core and the band of counties immediately surrounding the metropolitan area of Gdansk-Gdynia-Sopot. Particularly strong clusters in the Pomorskie region occur in shipbuilding and the transport, shipping and logistics sector based on the two main seaports (thus maritime economy sector), jewellery (in particular amber jewellery) and the ICT sector. Some of the officially registered clusters or cluster initiatives, however, are not associated with major regional specialisations.

Exports

Pomorskie ranks first among Polish regions in terms of the ratio of exports to GDP and second in terms of exports per capita (Table 2.2).[5] This strong export performance is mainly due to domestic firms – the share of foreign-owned entities in the exports of Pomorskie is the lowest among Poland's regions (33.6% in 2015). Pomorskie is one of the regions of Poland with moderate intensity of intra-industry trade[6]. Most of its exports are generated in the metropolitan Tri-City area[7].

Table 2.3. Export trends, Pomorskie and Poland

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
The share of Pomorskie in Poland's exports (percentage)	8.0	8.0	8.1	7.4	6.9	6.9	7.6	8.1	8.5	9.2	8.9
Exports per capita (thousand EUR)											
Pomorskie	2.6	3.2	3.7	3.9	3.1	3.8	4.7	5.3	5.9	6.8	7.1
Poland	1.8	2.2	2.6	3.0	2.5	3.1	3.5	3.7	4.0	4.3	4.6
Exports share in GDP (percentage)											
Pomorskie	40.4	44.7	45.4	41.1	36.7	40.0	47.0	51.2	57.2	64.2	-
Poland	28.6	31.8	32.2	31.0	30.4	32.7	35.3	36.6	38.7	39.8	-
Share of foreign-owned entities in exports (percentage)											
Pomorskie	32.0	34.9	37.6	36.0	35.1	35.6	27.5	29.3	29.1	32.1	33.6
Poland	54.5	53.7	54.8	53.4	53.5	52.2	50.7	48.1	47.3	46.0	45.2

Source: Own calculations based on data obtained from the Customs Office.

Substantial exporting is a positive aspect of the regional economy from the point of view of potential market growth and exposure to international competition and knowledge flows, which can be expected to promote productivity growth. On the other hand, the openness of the regional economy to trade may be accompanied by a relative vulnerability to economic shocks.

Table 2.3 presents the revealed comparative advantage (RCA) of Pomorskie for products that have shares in exports higher than 0.5% and for which RCA exceeds the value of one (which indicates revealed comparative advantage). Products with both high RCA indices and high shares in the exports of Pomorskie tend to be in sector 89 "ships, boats and floating structures". In particular, for CN8901 (cruise ships, excursion boats etc.) the RCA index equalled 11.6 and the share in the exports of Pomorskie equalled 23.3% in 2013-15.

[5] Data on exports for Poland's regions is based on the place in which the business entity has its head office. In order to obtain comprehensive results, the exports of the so-called undetermined region were recalculated and added to the 16 voivodeships according to their share in overall exports of Poland.

[6] See more: Umiński S., 2014, *Integration of Poland's regions with the European Union: assessment of intra industry trade relations*, European Integration Studies, 8, p. 93-98.

[7] For the role of metropolises in the trade of regions, see more in: Brodzicki T., Umiński S., (2016) *A gravity panel data analysis of foreign trade by regions: the role of metropolises and history*, Regional Studies, http://dx.doi.org/10.1080/00343404.2017.1296123

Furthermore, the RCA in most of these subsectors grew between 2005-2007 and 2013-2015. In addition, the region has a high export share and RCA in the petroleum industry.

Box 2.1. Calculation of the revealed comparative advantages of Pomorskie by sector

Revealed comparative advantages for Pomorskie have been identified using an RCA (revealed comparative advantage) index.[8] The index has been constructed as follows:

$$RCA_i = \frac{EX_{i,Pom}}{EX_{i,PL}} \Big/ \frac{EX_{Pom}}{EX_{PL}}$$

where: RCAi = revealed comparative advantage for product i for Pomorskie; $EX_{i,Pom}$ = value of exports of product i for Pomorskie; $EX_{i,PL}$ = value of exports of product i for Poland; EX_{Pom} = value of overall exports for Pomorskie; EX_{PL} = value of overall exports for Poland.

The index can be interpreted as the contribution of Pomorskie to Poland's exports of product *i*, relative to the contribution of Pomorskie to Poland's exports (for all the exported products). Individual high value export transactions (for instance associated with the longer cycle of building ships) can significantly influence the value of exports of a particular product in particular year. Therefore, the pattern of the revealed comparative advantages would strongly change over time. In order to eliminate such a bias, RCA indices have been calculated for three-year sub periods (2005-07 and 2013-15).

Source: Author

[8] See more in: Umiński S., (2012). *Rozważania nad naturą, przyczynami oraz konkurencyjnością działalności eksportowej w ujęciu regionalnym dla Polski*, WUG and in: Gawlikowska-Hueckel K., Umiński S., eds. (2016)., *An Analysis of Poland's Foreign Trade in the Light of the Latest Theoretical Concepts. Implications for Economic Policy at a Time of Crisis*, Scholar Publishing House, Warsaw

Table 2.4. Revealed comparative advantages, sectors with high export content in Pomorskie, 2005-07 and 2013-15

Higher values of RCA represent greater regional competitiveness

CN	Product	RCA 2005-2007	Share in exports in 2005-2007	RCA 2013-2015	Share in exports in 2013-2015
8904	Tugs and pusher craft	13.1	0.9	13.5	0.8
8905	Light-vessels, fire-floats, dredgers, floating cranes, floating docks etc.	12.6	1.5	12.7	2.3
8901	Cruise ships, excursion boats, ferry-boats, cargo ships, barges	10.9	24.3	11.6	23.3
8906	Other vessels, including warships and lifeboats	9.2	1.9	11.2	1.3
8902	Fishing vessels; factory ships	13.1	1.6	9.7	1.4
0305	Fish, dried, salted or in brine; smoked fish	10.1	2.8	9.3	3.6
4810	Paper and paperboard	11.6	1.2	8.8	0.9
2707	Oils and other products of the distillation of high-temperature coal tar	0.0	0.0	7.4	0.5
2710	Petroleum oils and oils obtained from bituminous minerals	7.0	8.8	7.3	14.8
9028	Gas, liquid or electricity supply or production meters	7.4	0.6	7.1	0.7
0304	Fish fillets and other fish meat	4.4	0.8	6.0	1.3
1001	Wheat and meslin	0.9	0.1	5.8	2.0
4802	Uncoated paper and paperboard	6.0	2.4	5.2	1.5
8903	Yachts and other vessels for pleasure or sports; rowing boats and canoes	4.0	0.8	4.8	0.8
2713	Petroleum coke, petroleum bitumen	7.0	0.5	4.3	0.5
1604	Prepared or preserved fish; caviar	2.4	0.5	4.1	1.0
3924	Tableware, kitchenware, other household articles of plastics	4.3	0.8	2.9	0.5
1205	Rape or colza seeds	1.7	0.1	2.8	0.6
8517	Telephone sets, apparatus for the transmission of voice, images or data	1.1	0.5	2.6	4.9
4418	Builders' joinery and carpentry of wood	2.1	1.2	2.5	1.3
8414	Air or vacuum pumps, air or other gas compressors and fans	0.4	0.1	2.3	1.2
7308	Structures and parts of structures (e.g. bridges and bridge-sections, lock-gates, towers etc.)	2.0	2.6	2.2	2.2
8483	Transmission shafts and cranks; bearing housings and plain shaft bearings; gears and gearing	1.8	0.6	2.1	0.7
8419	Machinery, plant or laboratory equipment	0.9	0.2	1.8	0.5
3925	Builders' ware of plastics	1.2	0.4	1.7	0.8

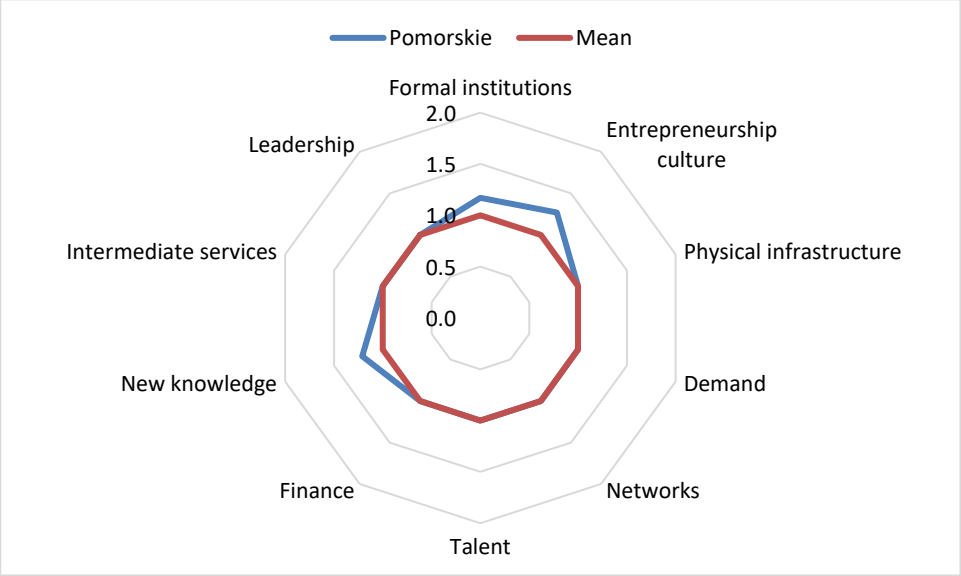
Source: Own calculations based on data obtained from the Customs Office.

2.2. The local entrepreneurship ecosystem

Data analysis has been undertaken for this case study to assess the strengths and weaknesses of the local entrepreneurship ecosystem in Pomorskie in comparison to all other Polish NUTS 2 regions. The analysis examines 10 ecosystem pillars, for which the data have been

normalised (the value of the variable minus the mean, divided by the standard variation) and standardised to give scores relative to 1. Figure 2.4 shows the results (details of the pillars, indicators and data sources are provided in Table 2.5).

Figure 2.4. The entrepreneurship ecosystem scores of Pomorskie by pillar, relative to the national mean



Notes: A score of 1.0 represents equivalence to the national average. A score above 1.0 indicates a strength of the region compared to the national average. A score below 1.0 indicates a weakness of the region compared to the national average.
Source: Author's elaboration.

Pomorskie scores below the national average on only two local entrepreneurship ecosystem pillars, namely 'networks' and 'finance'. Although it is not far away from the Polish mean on these pillars, this evidence nonetheless suggests relative priorities for the region in strengthening its entrepreneurship ecosystem. The position of Pomorskie is strongest compared with the national average on the pillars of 'entrepreneurship culture' and 'new knowledge'. Further details on the values and rankings of regions on the entrepreneurial ecosystem index are provided in Tables A1 and A2 in the annex.

Table 2.5. Information used for the local entrepreneurship ecosystem index

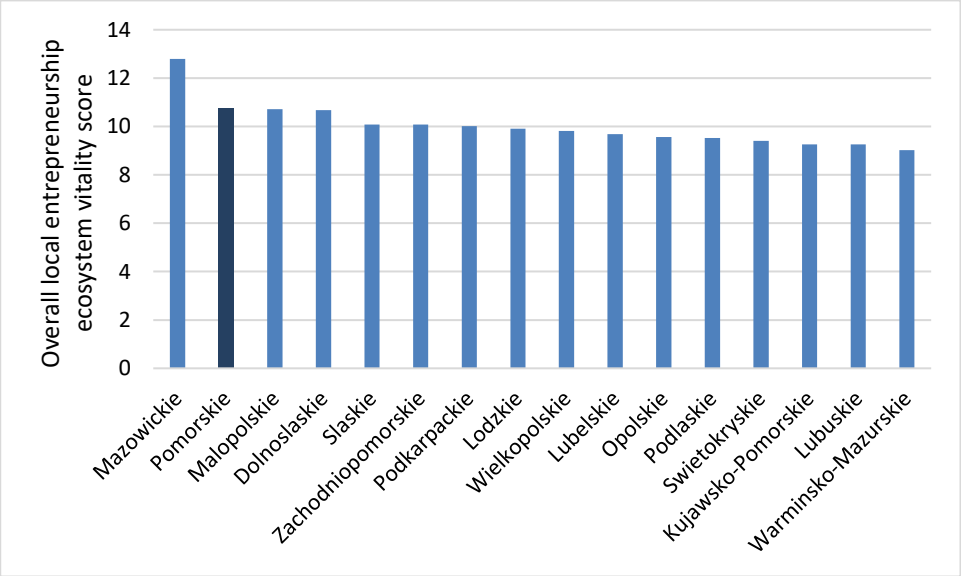
Pillar	Proxies used	Source of data
1. Formal institutions	• European Quality of Government Index (EQI)	Charron et. al. (2016), *The Quality of Government EU Regional Dataset*, version Sep16. University of Gothenburg: The Quality of Government Institute, http://www.qog.pol.gu.se
2. Entrepreneurship culture	• New firms per 1 000 inhabitants	*OECD Regional Statistics Database*
3. Physical infrastructure	• Motorways (kilometre/1 000 km^2) • Air transport (passenger departures and arrivals - thousands) • Railways (kilometres/1 000 km^2)	Charron et. al. (2016), *The Quality of Government EU*, Regional Dataset, version Sep16. University of Gothenburg: The Quality of Government Institute, http://www.qog.pol.gu.se
4. Demand	• GDP at current market prices, PPP per inhabitant • GDP at current market prices, million PPP • Population of the region	*OECD Regional Statistics Database*
5. Networks	• Number of industrial enterprises co-operating in a cluster initiative or other formalised co-operation as share of innovation-active enterprises	*Bank Danych Lokalnych GUS* https://bdl.stat.gov.pl/BDL/
6. Talent	• % of population 25-64 years old with tertiary education (levels 5-8)	*OECD Regional Statistics Database*
7. Finance	• Bank credit and loans as % of revenues from total activity	*Bank Danych Lokalnych GUS* https://bdl.stat.gov.pl/BDL
8. New knowledge	• Total expenditure on R&D as % of regional GDP)	*OECD Regional Statistics Database*
9. Intermediate services	• Employment in knowledge-intensive market services (% of total employment)	*OECD Regional Statistics Database*

10. Leadership	• Value of signed co-financing agreements from the national innovative economy Operational Programme; • Value of signed co-financing contracts for the Regional Operational Programme • No. of active research units by executive sector – total per 100 000 inhabitants	*Bank Danych Lokalnych GUS* https://bdl.stat.gov.pl/BDL/

Source: Author's elaboration, OECD.

An overall index has also been calculated for the Pomorskie local entrepreneurship ecosystem as a sum of the 10 pillars, assuming an equal significance or weighting for each pillar. The overall value of index for Pomorskie is 10.74, which is the second highest among Polish regions after Mazowieckie – the capital region (Figure 2.5). This indicates that overall the local entrepreneurship ecosystem is healthy, at least when compared to other Polish regions.

Figure 2.5. The overall entrepreneurial ecosystem vitality of Pomorskie relative to all Polish NUTS 2 regions



A score of 10 represents equivalence to the national average. A score above 10 indicates a strength of the region compared to the national average. A score below 10 indicates a weakness of the region compared to the national average.
Source: Author's elaboration.

2.3. Regional development policy arrangements

Regional government and development organisations

The regional level has an important role in economic development policy in Poland. There are elected regional governments in each of the 16 regions, which have the main responsibility for strategy development. In addition the central government has a representative in each region. The regional government has some responsibilities for certain public services like higher education, health, culture, economic development, environmental protection, and regional infrastructure. The work of the regional governments includes managing the development and implementation of Regional Operational Programmes (ROPs) related to key EU financing streams.

Entrepreneurship and business development is a key priority for the Pomorskie regional government. Among its key economic development partners in this endeavour are:

- **Pomerania Development Agency Co. (Agencja Rozwoju Pomorza SA)**, first established in 1992. The development agency carries out a range of economic development projects for the regional government, including implementing EU funding for entrepreneurship in the region.
- **Invest in Pomerania** is a regional non-profit initiative that supports FDI in Pomorskie. It undertakes investment promotion activities and offers aftercare services to inward investors, including by acting as a "one-stop shop" for inward investors to a range of government and non-government services.
- **Pomorskie Science and Technology Park (PSTP)**, was established in 2001 and is located in Gdynia. Its objective is to strengthen the region's competitiveness through the development of technology, innovation and entrepreneurship.
- **Gdansk Science and Technology Park (GSTP)** is part of the Pomorskie Special Economic Zone. The Park is mainly focused on biotechnology, IT and energetics. It is active in stimulating co-operation, exchange of experience, creative ideas, and promotion of new technology. Over 100 innovative companies are located in the Park.

The regional development strategy

The Pomorskie regional government's economic development vision is set out in the Pomorskie Region Development Strategy 2020 ("Pomorskie 2020"). This aligns well with national and European strategic policy documents. The strategy sets out the following high level vision:

- A region of sustainable growth, which launches and uses diverse territorial potentials to strengthen and balance the development processes.
- A uniquely positioned region, thanks to the activities of civil society, strong social and intellectual capital, rational management of environmental resources, economic use of the potential of the sea and intelligent infrastructure networks, and widespread use of eco-effective technologies.
- A leader of social and economic improvement in Poland and the South Baltic area.

Pomorskie 2020 includes three strategic objectives: a modern economy, active residents, and an attractive space, which are associated with 10 operational objectives (Table 2.6).

There are a further 35 directions of action associated with these objectives (see Table A3, Annex). There are six regional strategic programmes for the delivery of the strategy, as identified in Table A3 (Annex). One of the pillars of Pomorskie 2020 is the smart specialisation strategy.

Table 2.6. Strategic objectives of the Pomorskie 2020 Regional Development Strategy

MODERN ECONOMY	ACTIVE RESIDENTS	ATTRACTIVE SPACE
High performance of enterprises	*High employment level*	*Efficient transport system*
Competitive higher education	*High level of social capital*	*Energy security and efficiency*
Unique tourist and cultural offer	*Effective educational system*	*Good environmental status*
	Better access to health services	

Source: Pomorskie 2020 Strategy (2017), Office of the Marshal of the Pomorskie Region

The regional smart specialisation strategy

Content of the smart specialisation strategy

The smart specialisation strategy of Pomorskie was developed to guide the region's policy support for research and innovation in the 2014-2020 EU programming period. Smart specialisations have been selected that are support by research and innovation activities funded by the European Regional Development Fund (ERDF) targeted specifically towards the smart specialisations.

The smart specialisation strategy of Pomorskie prioritises the following four smart specialisations:

1. Offshore, port and logistic technologies.
2. Interactive technologies in an information-saturated environment.
3. Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction.
4. Medical technologies in the area of civilisation- and ageing-associated diseases.

As per other regional smart specialisation strategies, specialisations were selected based on the principle of utilising the region's unique assets to develop its distinct comparative advantages.[9] More specifically, the criteria behind the selection of the four smart specialisations were as follows: relationships to global trends, market potential, economic and technological potential, domestic and international benchmarking, strategy and action plan, and the potential of the partnership.

The first specialisation (maritime) relates to a large traditional area of activity for the regional economy. A key issue relates to whether there is sufficiently strong potential for growth in the specialisation in the future.

[9] European Commission (2014), Thissen et al., 2013

The second specialisation (ICT) also relates to a large existing concentration of value-added and employment in the region, although it is a newer activity than much of the maritime sector in the region. It is quite a broad specialisation and a danger is that if support is provided to firms in general for ICT projects, rather than to ICT firms, then support could be diluted across the regional economy, undermining specialisation principles.

The third and fourth specialisations (energy and medical technologies) have smaller critical mass but are related to some strong local assets and offer potential growth opportunities.

The four priority areas are significantly varied in terms of the nature of technologies and the market potential. This helps to provide a resilience to the smart specialisation strategy.

Involvement of local stakeholders in the smart specialisation strategy

Industrial transition processes tend to be led by combinations of local actors from research, business and government. Smart specialisation policies therefore need to involve these actors. The Pomorskie regional government established an effective process for involving stakeholders in the smart specialisation strategy by implementing a bottom-up Entrepreneurial Discovery Process (EDP), following good practice guidance set out in the EU Smart Specialisation Platform.

In a first stage, the regional government issued a call for interest from research and industry in creating partnerships for research and innovation in potential smart specialisation areas. Existing cluster organisations in Pomorskie that had been established in the 2007-2013 EU programming period were included in this call and involved in the entire process alongside other actors. In a second stage, the partnerships submitted proposals for research and innovation projects in their proposed specialisations. In a third stage, seven partnership and smart specialisation proposals were selected and fully evaluated. In a fourth stage, four Pomorskie Smart Specialisations (PSS) were finally selected.

As highlighted by Kamrowska-Zaluska and Soltys (2016):

"*Regional Government invited all actors to create a partnership. They worked on identifying potentials, and then based on this analysis, developed a common strategy for the development of smart specialisation. The method of identification of the priorities and implementation of the actions assumes that the process itself should be flexible, meaning that adopted priorities and allocation of resources need to be reviewed and modified if such a need occurs"*.

The use of the EDP has achieved a high degree of local commitment to the development of the smart specialisations and working groups for each smart specialisation have continued to meet.

2.4. Conclusions

Pomorskie has many advantages for stimulating innovative start-ups, scale-ups and SME innovation and strengthening its smart specialisations compared with other Polish regions. Its economy and population are growing. Healthy entrepreneurship dynamics are illustrated by a dense enterprise population, high numbers of enterprise births and a significant presence of high growth enterprises, although the latter are relatively small. The region has also attracted substantial FDI and has relatively high R&D expenditure in a Polish context. An assessment of the local entrepreneurship ecosystem shows key strengths compared with other Polish regions in the areas of 'entrepreneurship culture' and 'new knowledge'.

However, this section also highlights issues that need to be taken into account in policy intervention for entrepreneurship and emerging industries. First, there is substantial economic diversity sub-regions, with the strongest economies and labour markets in the metropolitan area in and around Gdansk, Gdynia and Sopot and the weakest points in the remoter rural areas of the region. Second, Pomorskie has ground to make up on many other EU regions outside of Poland, being classed as only a "moderate innovator" region at present in EU terms. Third, labour productivity in the region has fallen since 2011, potentially reflecting a structural shift towards a more service-based economy. Fourth, there are some local entrepreneurship ecosystem weaknesses compared with other Polish regions in the areas of 'networks and 'finance' although Pomorskie is not far below the average in these areas. Finally, recent structural economic changes and the upswing in the business cycle have revealed a shortage of labour, including skilled workers, particularly in the Tri-City area, which is a serious bottleneck to development.

The regional government has developed a smart specialisation policy using an entrepreneurial discovery process that closely involves stakeholders in identifying and implementing priorities and projects. The strategy contains four smart specialisations. Two focus on relatively large existing industry concentrations – namely maritime (including shipbuilding) and ICT. Two focus on smaller industry concentrations, which may have important potential for growth – namely energy and medical technology specialisations.

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3. Stimulating innovative start-ups and scale-ups

This section examines enablers and bottlenecks to innovative start-up and scale-up enterprises in the Pomorskie local entrepreneurship ecosystem and makes policy recommendations. Among the enablers is a range of policy supports and support infrastructure for start-ups and scale-ups. Key bottlenecks are a shortage of skilled workers in the region, barriers to academic entrepreneurship, and problems in access to finance. More needs to be done to stimulate talent attraction, foster linkages between academia and industry, and stimulate the availability of early-stage risk capital.

3.1. Introduction

Innovative start-ups and scale-ups underpin much of the risk-taking activity of the regional economy of Pomorskie, taking new ideas, technologies, initiatives and innovations into the market. Innovative start-ups and scale-ups also have a key role to play in supporting regional industrial diversification into industries that are new to the region or extend existing ones.

The ability of regions to support innovative start-ups and scale-ups depends on a multitude of factors in the local entrepreneurship ecosystem. These can be categorised, for example, into institutional conditions (regulations, entrepreneurship culture, networks) and access to resources conditions (talent and skills, knowledge, finance, leadership, business support services, demand and connectivity infrastructure) (Stam, 2018).

3.2. Enablers in the local entrepreneurship ecosystem

Entrepreneurship culture

Data on start-up activity shows that Pomorskie has the second highest regional rates of entrepreneurship in Poland after Mazowieckie (see section 2 and Masik and Rzyski, 2014). In particular, the Tri-City area is a thriving centre of entrepreneurship where many successful tech companies are based – which has been even referred to as the "start-up metropolis".

Knowledge generation

Pomorskie is endowed with as many as 28 state and private HEIs. They have an important role in generating knowledge, some of which could contribute to start-up and scale up activities, particularly knowledge about technologies. To facilitate the link to entrepreneurship, technology transfer offices are widespread in Pomorskie, despite a relative newness in Poland as a whole. HEIs in Pomorskie have also developed close connections to the regional government and fulfil a role as entrepreneurial universities.

Demand

Economic growth has been important in Pomorskie in recent years, which is a significant driver of regional demand growth that can benefit innovative start-ups and scale-ups. In addition, the local entrepreneurship ecosystem offers important links to sources of global demand. The Tri-City area is an important hub of the Baltic Sea Region (BSR) and acts as a gateway to the Scandinavian and German markets. Pomorskie also has a strong presence of foreign investment, particularly in shared service centre (SSC) and business process outsourcing (BPO) activities, which helps underpin the ICT smart specialisation. These connections provide opportunities for the local entrepreneurship ecosystem to access global supply chains and networks.

Business support services

Pomorskie has a well-developed public support system for innovative start-ups and scale-ups. This includes important business support infrastructures and programmes, many of which have received public support from EU funds (infrastructure and "soft" support).[10]

- Science and technology parks: There are two science and technology parks located in the Tri-City area: the Gdansk Science and Technology Park (GSTP) and the Pomeranian Science and Technology Park (PSPT) in Gdynia.
- Incubators: STARTER is one of the most important business incubators in Gdansk, operated by the City of Gdansk with the Gdansk Entrepreneurship Foundation. Between 2012 and 2017, 129 start-ups (up to 36 months old) had offices in the incubator. Additionally, over 300 start-ups have had virtual offices under the STARTER address. 12 start-up companies participated in the acceleration programme STARTER ROCKET, under which they received over 70 hours of training and over 70 hours of advisory services. Since the beginning of 2017, the start-ups at STARTER have received about PLN 50 million external investments.[11] In Gdynia, the City authorities have established the Gdynia Innovation Centre and the Gdynia Business Incubator.

  In addition, the national Foundation of Academic Incubators of Entrepreneurship supports incubators at Gdansk University of Technology and the University of Gdansk as a part of a national network of incubators established under agreements with HEIs. These incubators offer a suite of basic start-up services to students and staff taking their first steps in preparing for a start-up including advice, support in the registration procedure, and an offer of seed financing (OECD/EU, 2017). Furthermore, in 2017, the Medical University of Gdansk received funding from the Ministry of Science and Higher Education for the Incubator of Innovation+ programme, jointly with the Gdansk University of Technology and the University of Gdansk.
- Co-working spaces. The O4, operating within the Olivia Business Centre, was founded by a private entrepreneur in 2015. It is the largest co-working space in Gdansk. By 2017, the centre had more than 500 members, including over 60 Polish and international start-up companies and several NGOs. In the centre, start-ups are provided with opportunities to interact with more established businesses in the Business Centre office complex. Another recent initiative is Clipster, a new private-public partnership to support early stage entrepreneurs with mentoring and co-working and living space in Gdansk.
- Accelerators. Accelerator programmes have been established with both private and public investments. In particular, the Constructors' Park at the premises of the former Gdynia Shipyard is a space for creators, designers, and construction

[10] Under the Regional Operational Programme for the Pomorskie Region 2007-13 of the European Regional Development Fund (ERDF) within the EU cohesion policy in the region, the regional government spent 19.6% of total allocated EU money on direct and indirect support for enterprises (Richert-Kazmierska, 2012).

[11] Information source – Author's own communication with STARTER, November 2017.

engineers and the Space3ac Accelerator provides comprehensive support to start-ups in the space industry.

- Scale-up mentoring from large firms. Scale-up enterprises in Pomorskie can receive mentoring and networking from large state-owned enterprises in the space industry and the Gdansk Science and Technology Park through the national Scale-Up programme, which receives funding from the National Centre for Research and Development (NCRD).[12] The programme aims to combine the potential of early stage innovative start-ups and entrepreneurs with the infrastructure, experience and resources of large established enterprises. Young companies also gain access to high-level mentors and the opportunity to gain experience and build networking, business partners, corporate clients and potential investors.

3.3. Bottlenecks in the local entrepreneurship ecosystem

Access to finance

Several public programmes support access to finance for start-ups and scale-ups in the region. They include support for accessing loans such as the Pomorskie Loan Fund, the Pomorskie Regional Loan Guarantee Fund, and the Pomorskie Development Fund.

In the area of equity finance, which is particularly important for innovative start-ups and scale-ups, there are important limitations. Polish venture capital funds are appearing and are starting to specialise or focus on specific sectors, which will raise standards and diversify the portfolio of deals (Beauchamp et al, 2017). However, they are still in an early stage of development and many deals are relatively small in volume when compared with other countries. The NCRD national Bridge Alfa Investment programme is helping to fill some of the gaps, offering venture capital financing for the commercialisation of state-funded research outcomes. In addition, Pomorskie is one of the six regions in Poland that can use ERDF contributions for loan, guarantee and venture capital funds to invest in enterprises through the EU JEREMIE initiative. However, more needs to be done. In particular, there is a gap in bridging the small amounts of finance which are available locally with more substantial venture capital funding opportunities from firms in places such as San Francisco, New York, London and Berlin. Inter-regional networks in the BSR and CEE, which are currently developing, are not yet sufficiently promoted.

Networks

There are a number of local networks between entrepreneurs in the region (e.g. Interizon and infoShare Academy), as well as international networks (e.g. infoShare). These are an important support to entrepreneurs, particularly in the ICT specialisation, which improves their access to a range of resources. However, regional entrepreneurship networks are not so strong in some other smart specialisations, such as medical technologies, and international networks are also under-developed. A further constraint is limited trust and social capital in general in Poland.

[12] *Narodowe Centrum Badań i Rozwoju* (NCBiR), or NCRD, is an agency of the Ministry of Science and Higher Education that seeks to promote the role of research in Polish competitiveness. Its programmes include the management of applied research programmes, commercialisation and technology transfer activities, and training of young scientists and researchers on commercialisation, intellectual property management and business development (OECD, 2017).

A further bottleneck concerns limited academic entrepreneurship activities and weak links between science and industry. This limits knowledge transfer and exchange activities from HEIs into the regional economy. Multi-level efforts, including reward and recognition systems, need to be co-ordinated at the senior leadership level of HEIs. For example, the Gdansk University of Technology created the position of Vice Rector for Internationalisation and Innovation to drive innovation activities and to build strong relationships with the business community and international partners (OECD/EU, 2017[2]). This type of approach is also recommended for other HEIs in the region.

Talent and skills

Pomorskie is one of four regions in Poland (including Mazowieckie, Wielkopolskie, and Małopolskie), where positive net migration has been recorded for a number of years (Masik and Rzyski, 2014). In principle this is an opportunity to obtain talent and skills for entrepreneurship. In addition, Pomorskie produces nearly 1 200 IT and electronics graduates every year and the overall number of IT and electronics students (including PhDs) is growing, in contrast to the rest of Poland (Matczak and Oberbek, 2013), Despite these advantages, start-ups and scale-ups in Pomorskie are suffering from shortages of skills and entrepreneurial labour.

In particular, there is a severe shortage of skilled IT personnel. This is not enough to meet demand. The growing shortage partly reflects declining unemployment in the region and strong demand for available IT workers from the region's multinational companies. Furthermore, current engineering and technical education does not provide students with sufficient business competences. These issues imply the need for an increase in the quantity of training places in digital skills and an increase in the business orientation of the training. An example of a good practice initiative in Pomorskie that is helping build the digital skills needed by employers is the BPO Education Centre at the Olivia Business Centre. This initiative involves training by Sopot University of Applied Science for BPO/SSC services in the region while supporting the career development of local residents.

A further issue concerns the limited focus of formal education on the development of entrepreneurship skills in the regional population. Some entrepreneurship education initiatives are in place in selected HEIs in the region, but these initiatives need to be scaled up and spread to all levels of education. An example of good practice in Pomorskie that merits wider take up – both in the region and elsewhere – is the students' enterprise society at Gdansk University of Technology (GUT).

In addition to stimulating entrepreneurial mind sets, an important role that HEIs can play in the region is to provide opportunities for graduates and staff to create start-up enterprises using knowledge from the HEI, through a range of support including with premises, advice, mentoring and financing. However, HEIs in the region note that entrepreneurial activities in their laboratories were not funded with European Structural and Investment Funds since they were commercial activities (or had elements of commercial activity). This practice of not awarding EU funds to HEI entrepreneurship support activities has been set by some regional managing authorities and is a major hindrance to developing entrepreneurial activities within HEIs, both in terms of supporting researchers in working with industry but also for providing students with practical opportunities to experience entrepreneurship (see OECD/EU, 2017).

3.4. Summary of enablers and bottlenecks

Table 3.1 provides a summary of key barriers and opportunities in the local entrepreneurship ecosystem, as per the entrepreneurship ecosystem pillars investigated by the OECD local entrepreneurship ecosystems work (Stam, 2018). The Table points to potential priority areas for policy action.

Table 3.1. Summary of key enablers and bottlenecks to innovative start-ups and scale-ups in the Pomorskie local entrepreneurship ecosystem

	Start-ups		Scale-ups	
	Enablers	**Bottlenecks**	**Enablers**	**Bottlenecks**
Institutions				
Entrepreneurship culture	- High start-up rate - High technology-based start-up rate	- Risk avoidance - Lack of entrepreneurial mind-sets		- Limited role models
Regulations				
Networks	- Key regional networks in ICT, e.g. *Interizon* cluster and *infoShare*	- Lack of trust	- Key regional networks in ICT, e.g. *Interizon* cluster and *infoShare*	- Lack of trust - Limited regional networks in smart specialisations other than ICT - Limited international networks
Access to resources				
Connectivity infrastructure	- International connectivity		- International connectivity	
Knowledge	- EU research and innovation funding - Substantial HEI presence	- Limited academic entrepreneurship - Limited university-industry collaboration - Limited R&D expenditure on product development	- EU research and innovation funding	- Limited academic entrepreneurship - Limited university-industry collaboration
Demand	- Growing GDP - Inward FDI		- Growing GDP - Inward FDI	
Business support services	- Science and technology parks - Incubators - Co-working spaces - Relocation support for innovative start-ups from elsewhere		- Science and technology parks - Accelerators - Scale-up mentoring - Relocation support for scale-ups from elsewhere	

Finance	- Public loan funds		- EU equity funds - NCRD equity funds	- Limited of venture capital and private equity - Limited international venture capital fund links
Talent and skills	- Low labour cost - Pool of skilled technical human resources - Linguistic skills - Training opportunities - In-migration	- Shortage of IT personnel - Insufficient business competences - Insufficient entrepreneurship skills	- Low labour cost - In-migration	- Rising labour cost - Shortage of IT personnel - Lack of management skills and experience
Leadership				

Source: Author's elaboration.

3.5. Conclusions and policy recommendations

The local entrepreneurship ecosystem in Pomorskie has helped many technology-based start-up companies to develop and take their innovative ideas and technologies to market. Innovative start-ups and scale-ups are making an important contribution to the development of the region's smart specialisations, particularly in ICT and medical technologies.

While there is a growing number of success stories and a variety of growth trajectories of technology-based start-ups, the number of scale-ups is still limited. There are currently no "unicorns" in the Tri-City area[13]. Policy can assist by strengthening the local entrepreneurship ecosystem of Pomorskie for innovative start-ups and scale-ups.

The most important bottlenecks for innovative start-ups and scale-ups are as follows:

1. Limited external capital for start-ups and scale-ups, particularly private equity funds.
2. A severe shortage of skilled human resources, particularly digital skills, as well as lack of skills of entrepreneurs to start and grow their businesses.
3. Limited collaboration between universities and industry, and weak academic entrepreneurship.

The following policy recommendations are offered.

Bridging financial resource gaps

Early stage funding remains a core challenge for entrepreneurs in Pomorskie. The local government may consider the establishment of a regional equity investment fund (see Box 3.1). Start-ups and scale-ups should also be better connected to venture capital fund networks in CEE and BSR countries in order to acquire more expertise in technologies and businesses. Technology conferences such as infoShare may be good vehicles to connect local start-ups with larger businesses and potential investors and the regional government can support awareness on the existence and networking opportunities of these conferences.

[13] Unicorns are start-up companies whose market value exceeds USD 1 billion. In January 2016, Fortune Magazine identified 229 such businesses, among them Poland's first unicorn – CD Projekt, a gaming company.

Box 3.1. The Scottish Co-Investment Fund, United Kingdom

Rationale and approach

The Scottish Co-investment Fund (SCF) is an equity investment fund established by Scottish Enterprise (the economic development agency for most of Scotland) in 2007, partly funded by the European Regional Development Fund. It was designed to address a finance gap through all the stages of venture development. For this purpose, the public sector invests alongside the "accredited co-investment partners" from the private sector. Unlike a standard venture capital (VC) fund or a business angel, the SCF does not find and negotiate investment deals on its own. Instead, it forms contractual partnerships with active VC fund managers, business angels and business angel syndicates from the private sector. The Scottish Investment Bank invests on equal terms with the investment partner.

The SCF can be invested in companies of various stages including start up and expansion into new products and/or markets. The investment amounts range from GBP 10 000 to GBP 1.5 million as part of total deal sizes ranging from GBP 20 000 to GBP 10 million. From 2009-2013, the fund invested GBP 45.5 million in 149 businesses, and levered private sector investment of GBP 74.5 million.

According to an evaluation of phase I of the programme (2007-2009), the fund had a positive impact upon the performance of the invested SMEs and on the wider Scottish economy in terms of turnover, Gross Value Added and employment. The fund achieved high levels of additionality, minimal displacement and strong impacts on exports.

Key strengths and weaknesses

The main strength of this model is private-sector leadership, which is key to its future success. It also makes important efforts to work with partners to identify potential deals that would benefit from investment readiness support and to support the fund's investments with other Scottish Enterprise products and services. A potential issue that has been identified is that the necessary private-sector leadership might become less significant as factors such as portfolio management become more dominant. This is being addressed by ensuring that the objectives of the fund are clearly communicated to all partners and investees.

Relevance for Pomorskie

This model offers an approach to addressing the equity gap for start-ups and scale-ups making use of EU funding. The co-investment model has been implemented at the regional level in several other EU countries.

Further information

https://www.scottish-enterprise.com/services/attract-investment/scottish-coinvestment-fund

Sources:

Regional Innovation Monitor, "Scottish Co-Investment Fund" https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/support-measure/scottish-co-investment-fund [23/02/18]

Scottish Co-Investment Fund Overview https://www.scottish-enterprise.com/services/attract-investment/scottish-coinvestment-fund/scif-overview [23/02/18]

Scottish-European Growth Co-Investment Programme http://www.eif.org/what_we_do/resources/scottish-european-growth-co-investment-programme/index.htm [23/02/18]

Scottish Growth Scheme https://www.mygov.scot/scottish-growth-scheme/ [23/02/18]

Talent attraction

Pomorskie is experiencing a shortage of skilled and entrepreneurial workers. A key response should be a talent attraction strategy with two elements. The first element involves increasing the focus and coherence of the region's branding and ensuring that it covers attraction of talented labour as well as FDI. This will require further branding and promotion work by the regional government, along with Invest in Pomerania, local authorities, development agencies, universities and larger businesses in the region. Specialisation would help, with the region's science parks, accelerators and incubators targeting specific technology areas in order to attract mobile talent.

The second element is a set of specific talent attraction initiatives targeting Polish expats, international students, technology talents, entrepreneurs and international managers with business experience and sought after skills in areas such as ICT. This will require developing international talent attraction networks around established organisations, providing information about regional benefits and opportunities for start-ups and scale-ups in the smart specialisations and for ICT and other skilled workers, potentially offering specific incentives for mobile talent to locate or start businesses in Pomorskie. Some of the business incubators (e.g. STARTER, Clipster) and co-working spaces (e.g. O4) in Gdansk are already hosting international entrepreneurs. The networks abroad of these people could be leveraged for further talent attraction. Lastly, a special emphasis could be placed on promoting the region as a destination for employment or entrepreneurship to potential returnees who previously lived in Pomorskie (see Box 3.2).

Box 3.2. Realising the potential of returnee entrepreneurs

Rationale and approach

An increasing number of governments at national and sub-national levels are developing policies to encourage highly-skilled people to return home from abroad, particularly engineers and scientists. Return migrants can be an important stimulus to entrepreneurship in the regions they originate from. For example, Annalee Saxenian (2006) documents the role of Chinese and Indian return migrants from the USA in founding and developing high-technology ventures in China and India. Kenny et al. (2013) also show the role of return migrants in the development of the ICT sector in these countries.

Enabling factors

From the mid-1990s, the Chinese government, particularly at the provincial level, has actively supported the return of highly-skilled migrants to set up businesses with the purpose of fostering entrepreneurship and promoting local economic growth. For example, the Entrepreneurship Acceleration Programme is offered by the Zhejiang Province and Hangzhou Municipal Government to support entrepreneurs to start their ventures in Hangzhou. Li and Xia (2014) found that venture capital investments in the region increased dramatically after the policy change, and that the investments made by foreign venture capital funds in returnee entrepreneurs had better exit outcomes than other venture capital funds.

Relevance for Pomorskie

Returnee entrepreneurs can transfer not only technology from overseas but also economic, cultural and social capital, helping transform the business culture and connecting it to the global economy. There are many talented people from Pomorskie working abroad who have an affinity for Pomorskie and can help stimulate innovation and entrepreneurship using the networks and competences they have developed abroad. A deliberate policy could be introduced to actively seek and support potential returnees to Pomorskie. A long-term strategy is required, including linkages to regional and external financial resources.

Sources: Kenny et al. (2013); Li and Xia (2014); Saxenian (2006)

Nurturing entrepreneurship skills

Entrepreneurship education should play a stronger role and be promoted at different levels of education (including schools, vocational education, higher education, and continuing professional development) and with different forms of delivery (in curricula, extra-curricular, short bespoke courses, professional training, training entrepreneurs overseas). In particular, emphasis should be placed on increasing extra-curricular provisions in universities and vocational schools, such as short courses and business competitions to increase entrepreneurship skills. Collaboration between levels of government (i.e. local, regional and national) will be important in this respect. Training initiatives for entrepreneurs may need to link up with international brands such as Stanford and MIT to develop leadership, management skills and mind-sets.

The region also suffers from a lack of experienced mentors to support newly formed businesses. More work could be done here to improve the local mentor infrastructure and incentivise large companies to provide staff as mentors to start-ups.

Increasing the supply of ICT workers

Although there is a strong supply of training for digital skills it is not sufficient to meet skills demand in this area. Increased investment is needed in digital skills training, with an emphasis on involving employers in the design, delivery and take up of the training.

Strengthening R&D and improving incentives for academic-industry knowledge exchange

Knowledge exchange between HEIs and enterprises in the regional economy is somewhat limited in Pomorskie. Measures are needed to help strengthen knowledge exchange, particularly in the smart specialisations. This may involve investment in public R&D related to the commercialisation opportunities in the smart specialisations, various incentives to increase business R&D and measures to encourage academic industry linkages. Box 3.3 gives the example of how investment in centres of excellence in the maritime industry in a key HEI and related skills and knowledge exchange activities has strengthened the regional economy in Trondheim, Norway (see Reve, 2009, for details).

Box 3.3. HEI regional knowledge networks – the maritime industry in Norway

Rationale and approach

The emergence of low cost maritime production in countries such as Korea and China combined with a downturn in the market has created increasing competitive challenges for the maritime industry in Northern Europe. Norway has maintained a strong maritime industry in ships and oil platforms through investments in advanced technological R&D and operational maritime knowledge. Knowledge exchange within the maritime industry is supported by the development of a modern knowledge infrastructure based around the Norwegian University of Science and Technology (NTNU) Oceans facility in Trondheim, including state-of-the art research labs, test facilities, simulation centres, and research commercialisation units.

Strengths and weaknesses

NTNU Oceans, along with MARINTEK/SINTEF, offers its R&D services to the maritime, offshore and marine industries and to commercial actors worldwide, as well as driving teaching and innovation. NTNU has also hosted CeSOS (Centre for Ships and Ocean Structures) and AMOS (Autonomous Marine Operations and Systems), both centres of excellence funded by the national research council, with 50 researchers and professors contributing to maritime firms and institutions focusing on hydrodynamics and maritime technologies. With multi-level co-ordinated efforts, local knowledge bases and skills have been built to advance the knowledge value chain in the sector.

Relevance for Pomorskie

Pomorskie has taken steps in the right direction to modernise its shipbuilding sector and to leverage the strengths of its research institutes. Key to future success will be the development of a modern knowledge infrastructure and attraction of highly skilled researchers able to further transform the industry. This could be supported by investments in an anchor R&D and training facility such as NTNU Oceans.

Sources:

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Use public procurement to stimulate demand for innovation

Demand stimulation and market access is an important policy lever for innovation and local economic development (Uyarra and Flanagan, 2010). The regional government should

promote innovation-friendly practices across all types of public procurement, in particular pre-competitive public procurement, in order to open new markets for innovative start-ups and scale-ups. For example, the "WienWin" initiative started in Vienna in 2009 aims to position Vienna as a "business location by using its purchasing power, through promoting the development of innovative products and services and supporting innovative businesses". As a result, the city has improved its image by promoting innovation, and the co-operation between the local government and local small businesses has been enhanced.

Box 3.4. Recommendations for stimulating innovative start-ups and scale-ups

Access to finance

1. Consider the establishment of a regional equity investment fund.
2. Better connect innovative start-ups and scale-ups with venture capital and private equity networks internationally, including in Central and Eastern Europe and the Baltic Sea Region.
3. Encourage and support start-ups and scale-ups to participate in technology conferences that offer networking opportunities for financing.

Skills and talent

4. Develop talent attraction initiatives aimed at attracting potential entrepreneurs and highly-skilled labour, including ICT, particularly in the smart specialisations. These initiatives can target Polish expatriates, international students and international managers with business expertise and leverage the presence of existing international entrepreneurs and their networks.
5. Offer more entrepreneurship skills development activities in formal education and continuing professional development, such as short entrepreneurship courses and business plan competitions.
6. Improve the local mentor infrastructure by incentivising managers in large companies to become mentors for potential and existing start-up and scale-up businesses.
7. Increase the local supply of training courses for ICT specialists as well as on-the-job digital skills training for non-specialists.

Innovation and knowledge exchange

8. Improve incentives for businesses to make use of academic research and strengthen initiatives to promote knowledge exchange between universities and businesses.
9. Use local procurement to stimulate demand for innovative start-ups and scale-ups in the smart specialisations.

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4. Engaging large enterprises in the local entrepreneurship ecosystem

This section discusses the engagement in regional entrepreneurship and innovation activities of large domestic and foreign businesses that are operating in Pomorskie. It argues that there is scope to increase the leverage of large enterprises as potential drivers of entrepreneurship and emerging industries in the region. This can be achieved through upgrading the knowledge content of large firm activities in the region and fostering corporate entrepreneurship and open innovation.

4.1. Introduction

Branches and subsidiaries of large domestic and international businesses are more than important sources of direct employment for the region. They are also potential drivers of entrepreneurship and emerging industries in the region by virtue of their advanced human, financial and knowledge resources and engagement in global production networks (GPNs). Generally, large firms have a vested interest in supporting the local entrepreneurship ecosystems that host them, but entrepreneurship and innovation linkages will not necessarily occur without appropriate trust and supporting public action.

4.2. Profile of large enterprises in Pomorskie

During the decades of post-socialist transition, Pomorskie has gradually been shifting from lower value-added production and assembly-based manufacturing towards higher value-added manufacturing and service-based activities, including business process outsourcing (BPO) and shared services centres (SSCs). This shift has seen an increase in foreign direct investment (FDI) in the region, alongside local operations of Polish corporations.

A first wave of FDI in the region started during the mid-1990s, and a second wave followed with Polish entry into the European Union in 2004. Between 2007 and 2010, Pomorskie was the sixth largest recipient of FDI in Poland. Notable FDI projects included Intel Technology Poland, Thomson Reuters (focused on data entry and management, including some software development), the Australian Macquarie Group, Flextronics from the United States, Lufthansa Systems from Germany, Galeon, Lotos, Arengar LPP (apparel industry) and Atena.

Brownfield investment was complemented by greenfield investment, including in special economic zones in the 1990s, which allowed larger companies to move into larger facilities where they could base divisions or branches. There have also been some important acquisitions of Polish businesses by foreign enterprises that can introduce new corporate cultures and resources, as was the case with Intel and Jeppesen. For example, today Gdansk is Intel's second largest R&D site in Europe, with six R&D businesses primarily focused on software development, as well as being a hub for human resources and sales support services in Europe, the Middle East and Asia.

Since 2011, the not-for-profit regional initiative Invest in Pomerania (IiP) has supported around 80 FDI projects that have seen approximately 12 000 new jobs created. Its FDI focus has been in six key areas: BPO/SSC, IT, Energy, Logistics, Chemistry, and Automotive. It is noteworthy that there is only a partial overlap between these areas and the four specialisations identified in the smart specialisation strategy. Overall, however, the majority of FDI projects have been in the BPO/SSC and information technology (IT) sectors. Furthermore, much of the FDI attracted has been located in the Tri-City area, with only a few examples in the rural areas.

Among the main reasons for the attraction of substantial FDI to Pomorskie is the presence of low labour costs, good market access, and a skilled IT workforce, which had begun to develop during the communist era, albeit in the service of military functions. The cost of labour in Poland is highly competitive compared to equally high-skilled, more developed economies. Overall, while 90% of the jobs attracted are estimated to be above the average wage, many are in process-based work. While there are examples of R&D-led inward investment in Pomorskie, these have tended to be through the acquisition of Polish businesses, as was the case of Intel, Amazon, Jeppesen and Thomson Reuters. These

examples are testament to the expertise in the region, which is also closely linked to the Gdansk University of Technology.

In terms of domestically-owned firms, Polpharma is the leading Polish pharmaceutical company and among the top 20 generic drug manufacturers in the world, and could provide a strong focal point for the medical technologies smart specialisation.

4.3. Challenges for embedding large firms in the local entrepreneurship ecosystem

Upgrading FDI knowledge and skills content

A key challenge for Pomorskie lies in increasing the strategic importance of FDI activity in the region with a view to performing more knowledge-intensive and skill-intensive functions. This implies an increase in the emphasis of the regional inward investment attraction strategy on attracting FDI that can stimulate activity around new technologies, knowledge transfer and higher skills Slaughter, (2001, 2002). Attraction of this type of FDI requires other types of assets than low labour costs, and should be pursued alongside aftercare and embedding; working with existing FDI to further develop their operations and activities in Pomorskie.

Like other Polish regions, Pomorskie has historically seen labour under-employment, with a workforce capable of more complex, higher-value work. In particular, the BPO and SSC sectors are key regional employers and attractive to prospective employees, with foreign-owned companies generally paying competitive salaries, as well as offering career development opportunities. Yet despite the positive perception of employees, large BPO and SSC firms in Pomorskie have tended to under-invest in upskilling their workforces. Although there are some signs that lower-level, more repetitive task-based jobs are being replaced by more mid-level jobs within the IT sector, under-skilling remains acute in the BPO and SSC sectors and also applies in a wider context.

On the other hand, some large companies such as Intel, Bayer and Thomson Reuters have acted as regional leaders in the upskilling existing employees, moving employees from "back office" functions to more strategically important areas of activity creating value, for example through Bayer's investment in a regional service centre in Pomorskie in 2011 (Bayer, 2017).

The regional government and its labour offices can play an expanded role in helping upgrade skills in FDI, by working with employers to find appropriately skilled workers and to train workers. At the same time, there is an opportunity to boost the FDI attraction and aftercare activities of Invest in Pomerania to seek to upgrade inward investments and align them better with the skills profile of the region.

In particular, in 2016, there were around 2 300 people working in R&D centres in Pomorskie, attracted by research, education and labour market strengths in the Tri-City area in the ICT sector together with a developing infrastructure including suitable premises. These types of assets need to be strengthened in order to attract new R&D subsidiaries and for established subsidiaries to become more R&D intensive.

Box 4.1 illustrates the approach that has been taken by Ireland in recent decades to upgrading the skills and knowledge content of its FDI.

Box 4.1. Upgrading the quality of FDI – the approach of IDA Ireland

IDA Ireland was set up by the Department of Industry and Commerce in 1949 as the Industrial Development Authority. It had the remit to work with domestic firms to promote exports and attract FDI, measures which contrasted to former policies of economic protectionism. Its mandate was expanded in 1994 when it was tasked to promote Ireland and attract high-quality FDI, and since the mid-1990s in particular, IDA Ireland has been central to supporting Ireland's economic rejuvenation.

Initially the focus of FDI was in the manufacturing and services sector attracted by financial subsidies and low taxation. However, through a process of industrial upgrading over time, the emphasis has turned to high-tech, knowledge-intensive and R&D activities. To achieve this, IDA Ireland sought to shape FDI flows to maximise their impact, building relevant resources and assets and targeting FDI in key sectors for the Irish economy. By the late 1990s, inward investment had created a vertically and horizontally integrated IT and electronics cluster, of which the cornerstones have been investments from Microsoft, Intel and Dell. More important than the capital investment and jobs created have been the linkages created between firms and the development of the workforce in Ireland. This has seen Ireland and the greater Dublin area become a "sticky" place for inward investment. In realising and building on this competitive advantage, the ICT cluster is now diversifying into augmented reality and virtual reality (AR/VR) technologies and has a thriving domestic tech scene.

FDI remains critical to the growth and diversification of the Irish economy and, as well as sustaining international connections, IDA Ireland attracted employers account for some 175 000 jobs, with an aim to increase to over 250 000 by 2020.

As well as providing services to attract FDI, IDA Ireland provides comprehensive aftercare with a dedicated team to assist with project implementation and build an ongoing relationship with attracted companies. As well as brokering introductions to particular companies, research centres and industrial bodies in Ireland, IDA Ireland is committed to understanding future needs to retain and grow FDI in Ireland to support reinvestment and supplier development programmes. In addition, IDA Ireland has come to assume a more strategic approach to attracting and embedding FDI based on its own monitoring and research to understand the dynamics and cycles of different industries.

Source: Author

Strengthening large firm-university links

Linkages between large firms and HEIs are a major aspect of the integration of large firms in a local entrepreneurship ecosystem and of knowledge exchange and support for industrial diversification. There are a number of good examples of research and innovation linkages between large enterprises and HEIs in Pomorskie. However, these linkages are uneven and there is scope for further development, both in research and innovation as well as in training and skills development. The regional government and Invest in Pomerania could both play important roles in incentivising and facilitating universities to engage and collaborate with large businesses in innovation and training.

Overall, large firms in the region tend to focus their linkages with HEIs on attracting talented graduates rather than on co-operation on R&D and innovation. This in part can be

explained by the fact that FDI has not historically been attracted to Pomorskie because of its knowledge or research base, but rather because of the comparatively highly skilled, low-cost labour or acquisition of a domestic firm (as was the case with Intel) and because MNEs tend to have a number of international university links and do not depend for knowledge on local HEI linkages.

On the other hand, there are examples of important large firm linkages with HEIs in the region in both skills and innovation. For example, Lotos and Intel are both involved in R&D and innovation-based activities as well as courses, workshops, conferences and events for skills development purposes. Further examples are provided in Box 4.2. These types of collaborations should be encouraged more widely.

Box 4.2. Examples of FDI-HEI linkages in Pomorskie

Polpharma-Medical University of Gdansk (MUG)

An example of a longstanding, multi-dimensional university-industry relationship in Pomorskie is that of Polpharma and the MUG. Premised around teaching, research and student recruitment, the relationship saw a new two-year master's degree at the Faculty of Pharmacy launched in 2017 to develop highly trained scientists with commercial awareness and experience, while also developing new interdisciplinary scientific projects with the Polpharma Development Centre.

Sopot University of Applied Sciences-Gdansk Employment Office

Sopot University of Applied Sciences has established an innovative recruitment programme with the Employment Office in Gdansk to train junior accountants for larger firms, together with companies such as Arla Global Shared Services, Swarovski Global Business Services, Thyssenkrupp Group Services, and Bayer. Close collaboration between universities and larger organisations is therefore important in shaping and aligning curriculum and programme design to prepare graduates for the employment opportunities presented by the presence of larger established businesses. This initiative also develops stronger educational and labour market development links with major employers investing in Pomorskie and ultimately builds deeper, longer-term links as well as ensuring employment demands are met. The role of the Employment Office in Gdansk has been instrumental in establishing these short courses and brokering the internship and six-month employment as part of the programme. The outcome represents a model for building capacity that also has longer-term prospects to support the embeddedness of upskilling and cultures of entrepreneurship.

Source: Author

Stimulating corporate entrepreneurship

The term "corporate entrepreneurship" is not new but has become increasingly fashionable over the past decade to describe the entrepreneurial behaviour of established and typically large organisations. There are many definitions, but generally it refers to "the process whereby an individual or a group of individuals in association with an existing organisation create a new organisation or instigate renewal or innovation within that organisation"

(Sharma and Chrisman, 1999). Much of the discussion on corporate entrepreneurship has focused on it can help large firms to realise the competitive advantage(s) of smaller entrepreneurial firms in terms of their ability to adapt and respond to opportunities and changes in the markets. Entrepreneurship is not typically associated with large firms because of their often bureaucratic structures, systems and cultures; however, this is changing as large firms are coming to view corporate entrepreneurship as a source of competitive advantage.

Birkinshaw (2003) summarises four basic types of corporate entrepreneurship:

1. **Corporate venturing**. This concerns how new venture activities are organised and aligned to the existing activities of a company, through which they can acquire knowledge and resources.
2. **Intrapreneurship**. This is essentially about individual employees acting entrepreneurially, which runs contrary to the systems and structures that many firms instigate to manage employees.
3. **Entrepreneurial transformation**. This focuses on how large firms adapt to changing market conditions by reforming organisational systems to incentivise more entrepreneurial behaviour.
4. **Bringing the market inside**. This concerns structural changes within the firm that reform the way in which resources are allocated through more market-oriented techniques.

There is potential for corporate entrepreneurship in Pomorskie in each of the above areas, reflecting the strong presence of large firm operations in the region. However, this will require some changes in culture and conditions in the region.

There is evidence in Pomorskie of large firms often not engaging with corporate entrepreneurship, or even in some instances actively discouraging it where they see it as distracting from their core activities or diluting commercial interest in their core products and services. In part this reflects a low trust environment that prevails amongst firms in the region. Furthermore, the potential for corporate entrepreneurship is closely bound up with the innovativeness of the site/subsidiary. Currently much of the R&D activity in Pomorskie large firms (e.g. Intel, Amazon and Jeppesen) is more development focused than research based and the nature of the work is less autonomous than in more research-oriented subsidiaries. Corporate entrepreneurship is generally greater where employees are encouraged and supported to introduce new ideas and pursue new development projects, but this tends not to be as prevalent in subsidiaries where the focus is either on lower-skilled tasks or on developing existing technologies.

In promoting corporate entrepreneurship, the regional government can therefore take an important step by seeking to upgrade the quality of inward investment, as well as promoting and showcasing existing examples of corporate entrepreneurship to contribute to a change in culture in the region in this respect.

Encouraging open innovation

The concept of open innovation focuses on opening up the innovation process to incorporate knowledge and solutions from outside a business in the R&D process (Chesbrough, 2003). Open innovation systems seek to encourage collaborative attempts to innovate, involving stakeholders from large firms, SMEs and academia. Specifically, open innovation refers to the model adopted by some large firms, such as P&G, to engage people

from outside the organisation to contribute new ideas and solutions to pre-defined problems. This has created important inter-organisational networks and collaborations that allow large and established businesses to insource and outsource work.

The main advantages of harnessing an open innovation platform include providing agile and flexible responses to the increasing demands brought about by shorter innovation cycles and consumer demand for new products and services (Enkel, Gassmann and Chesbrough, 2009). Open innovation does not mean replacing in-house (or closed) forms of innovation or eroding a locus of control and quality management; it serves instead as a different approach to complement or extend existing innovation systems that can create important value for a region. Developing a more open approach to innovation has advantages for the large businesses in the form of developing fresh ideas from outside the company and distributing risk outside of the company's regime. It also supports regional development by strengthening innovation and entrepreneurship activity.

At present, a broad open innovation platform does not exist in Pomorskie. Its development would require the region's large firm subsidiaries to relinquish some control over their own innovation platforms and allow other organisations to develop complementary ideas and technologies. Regional smart specialisation policy can play a significant role in this regard, as it can be used to channel public funding to support R&D and innovation projects that can complement and extend directions of development being pursued by the region's large firms and invest in spaces for small businesses to explore and experiment in developing innovations that can integrate them into the networks of larger businesses.

Some attempts at integrating entrepreneurs and SMEs in an open innovation system are already being pursued in the region by individual corporate decisions and initiatives, such as the start-up accelerators run by Lotos and Energa. Some companies are very invested in this type of activity, as shown by the Bayer CoLaborator laboratories model described in Box 4.3. This type of initiative could be supported by policy. There is also an opportunity for policy to create innovation centres as a visible source of talent and ideas that can encourage large firms to engage in collaboration (Carayannis and Meissner, 2017).

Box 4.3. Bayer "CoLaborator" incubator labs, Berlin and San Francisco

In pursuit of open innovation, the global chemical, pharmaceutical and life sciences company, Bayer AG, has established two start-up incubator labs. The so-called "CoLaborators" offer office and laboratory space to start-ups based on pharmaceutical R&D at specialist premises alongside Bayer's science and innovation hubs in Berlin and San Francisco. The CoLaborators help foster exchange of ideas between Bayer and the start-ups, as well as building closer links with scientific networks, universities and research institutes, the wider bio-life science community and other pharmaceutical companies.

As well as creating the conditions for new companies to develop, the Colaborators embed and consolidate Bayer as an important anchor institution in the regional innovation and entrepreneurship ecosystems. With many of the companies working in areas of interest to Bayer, the CoLaborators provide important hubs for promoting knowledge and spillovers that benefit the wider life sciences communities.

Source: Author

Open innovation will not work in the same way in each of the Pomorskie smart specialisations, as the nature, scale and intensity of collaboration should depend on sector and firm demands, and this has an impact on how regional policy can support each smart specialisation:

- In the maritime smart specialisation, the main focus of collaboration is currently co-production rather than open innovation. This is not to say that barriers to open innovation for companies in this smart specialisation cannot be overcome. The Port of Gdansk Authority Co. is encouraging companies to engage in EU R&D projects and, by implication, project partners. There is also work with universities in Poland, as well as overseas companies in Norway and Spain, to generate new innovations. Some of these companies are start-ups but others are large firms within the region. Such work can bring SMEs and larger companies together to enhance the value added of the ports.
- Open innovation is very well suited to the ICT smart specialisation and the development of digital technologies, human-AI interfaces, and other future technological development. More open innovation would strengthen this smart specialisation by diversifying the actors and participants in the innovation value chain and the potential sources of knowledge diffusion and acquisition.
- The energy smart specialisation is not currently involved in substantial open innovation in the region, but greater collaboration between large firms and HEIs in the region would be a starting point.
- In the medical technologies smart specialisation, Polpharma has a close collaboration with HEIs on scientific research solutions to projects. This can be

expanded and greater attention paid to strengthening linkage between Polpharma and start-up support activities.

- In addition, there is important open innovation potential for Pomorskie in cross-cutting technologies that span the smart specialisations.

Whilst some regional large firms are using platforms such as hackathons to horizon-scan for technology and talent, a shift to a broad open innovation system will provide better value, which belongs to the region rather than specific large firms. The regional government can support this with investments in technologies for data analysis, machine learning, AI and other emerging regional strengths and providing networking and shared platforms that overcome barriers of trust and sustain a common goal and focus for partnerships in innovation.

4.4. Conclusions and policy recommendations

Upgrading and embedding large foreign and domestic firm activities

The substantial presence of large foreign-owned and domestic firms in Pomorskie has tremendous capacity to stimulate entrepreneurship and emerging industries. This is especially true where inward investments establish linkages and collaborations with other firms, entrepreneurs and universities in the region. However, a key condition for this to occur is the presence of a high strategic, knowledge and skill content of the investment. Pomorskie in the past has tended to attract FDI based on cost factors – notably cheap labour – and while some upgrading has occurred, more is needed in order to facilitate greater large firm embeddedness in the local entrepreneurship ecosystem.

To attract higher value-added FDI, the regional government – through Invest in Pomerania – needs to develop and market clear value propositions as to the benefits of the regional economy for innovative and entrepreneurial large firm activity. In addition, skills development programmes with large firms can help build their embeddedness in the region. These efforts demand that regular contact is sustained with subsidiary management of local FDI operations through boosted relationship management and aftercare activities. These activities will aim to encourage large foreign and domestic firms to develop and consolidate their presence in the region. As well as prioritising the attraction of high quality FDI, Invest in Pomerania is well placed to support subsidiary development by engaging more with large firms to better understand their current and future needs and challenges and how they could be supported by the regional government and other stakeholders.

Creating a culture of open innovation

Large firms in innovative economies are increasingly mobilising open innovation processes for their own development purposes, with important benefits for the regional economies in which they are located. However, in Pomorskie, despite some sparks of open innovation activity, large firms are not generally driving regional open innovation platforms. These would involve a wide range of deliberate external networking, various co-development research and innovation partnerships, and efforts to generate and absorb local knowledge spillovers. The regional government can play an important role by supporting networking and collaboration initiatives pioneered by regionally-embedded lead companies as open innovation champions.

An important opportunity for the regional government is to develop spaces for knowledge and information sharing that create a strong “local buzz”. In addition, policies aimed at

proactively promoting public-private interactions are important, especially between universities and businesses. Incentives can also be important, where appropriate, providing financial incentives to facilitate and support engagement by large firms. Such measures will be important in overcoming the trust deficit that is recognised to be a significant barrier to the open innovation of organisations and is a particular issue in Pomorskie and Poland in general. Creating a more open innovation culture is a longer-term project, but one that can be accelerated if supported by the regional government and intermediaries.

Box 4.4. Recommendations for engaging large firms in the local entrepreneurship ecosystem

Upgrading and embedding large foreign and domestic firm activities

1. Research detailed value propositions to attract high value-added inward FDI projects in the smart specialisation fields, indicating local assets and resource availability. Take initiatives to increase research, innovation, skills and entrepreneurship in these fields so as to boost the value propositions.
2. Strengthen aftercare support to FDI (such as regular one-to-one meetings with investors) to understand how to support FDI to reinvest and develop in the region.
3. Encourage large enterprises in the region to increase the generation of higher-level skills by strengthening their involvement in skills development initiatives involving secondary, vocational and tertiary educational institutions and supporting on-the-job training within large companies.

Creating a culture of open innovation

4. Increase understanding of the methods and benefits of open innovation processes among local stakeholders (SMEs, HEIs and research organisations, and large firms).
5. Support large firm open innovation platforms in the region by funding related innovation projects by potential partners, including SMEs, and establishing related innovation centres. Encourage local large firms to take active roles in shaping the form of these innovation funding streams and innovation centres.
6. Increase local awareness of corporate entrepreneurship processes and their benefits for large firms, and offer support to large firms facilitating corporate spin-outs.

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5. Knowledge exchange and path development in the smart specialisations

This section discusses enablers and bottlenecks to knowledge diffusion and path development in the four smart specialisation priority areas identified in the smart specialisation strategy of Pomorskie. It also examines connections across the four smart specialisations and the extent to which "social brokers" have been able to build connections across different fields and industries. The section shows that the chosen smart specialisations offer excellent opportunities for industrial transition, albeit on different pathways. The section offers a number of policy recommendations, which focus on addressing barriers to innovative start-ups and university-industry collaborations and taking further initiatives to support cross-fertilisation across smart specialisations.

5.1. Introduction

This section examines industrial transition in the smart specialisations of Pomorskie. Industrial transition can follow a number of different pathways – notably industry upgrading, industry diversification and industry emergence (Grillitsch, 2018). This section identifies the pathways being followed by the smart specialisations in Pomorskie, the networks supporting the development of the smart specialisations, and how to overcome bottlenecks and take advantage of enablers to the growth of the smart specialisations.

The importance of knowledge exchange

Industrial transition is inherently knowledge driven (Foray, David and Hall, 2009) and knowledge exchange and the creation of new knowledge combinations are fundamental to the development of the smart specialisations of Pomorskie. For example, Powell, Packalen and Whittington (2012) describe in a study of several US biotech clusters that these clusters were not necessarily established in regions that seemed most promising, but in regions where local actors were best able to connect new knowledge with regional capabilities.

Enablers and bottlenecks in knowledge exchange

Knowledge exchange occurs through social networks that channel information, influence and access to scarce resources. These networks influence who comes up with an innovation, whether and how rapidly the innovation is adopted and who has the ability to commercialise it. Strong social networks within an industry promote knowledge exchange and its exploitation for industrial transition.

Furthermore, knowledge exchange often involves utilising knowledge from existing industries in new industries, through processes of "regional branching" of existing industries into technologically related industries (Frenken and Boschma, 2007). Networks across industries are therefore potentially as important as networks within industries.

An important function facilitating knowledge exchange within and across industries is that of a "social broker". This is an individual or organisation taking the position of a "multiple insider". Such an insider has implicit knowledge in two or more different fields – e.g. different domains, sectors or clusters – and is able to connect actors across these fields. In addition, the strong involvement of the "social broker" in two groups also allows him or her to mobilise the resources necessary to put the idea into practice.

This dynamic, where multiple insiders connect previously unconnected groups, offers important opportunities for entrepreneurship. Entrepreneurs establish firms in those technological areas where they have access to knowledge (Sorenson, 2005). Additionally, entrepreneurs "mindfully deviate" from established pathways.

The role of smart specialisation policy

A range of potential bottlenecks may constrain knowledge exchange in a local entrepreneurship ecosystem. They may include lack of incentives for universities to engage in innovation development with industry, lack of labour mobility across firms and industries, lack of social capital and networks, and lack of "social brokers". Smart specialisation policy has a key role to play in overcoming these types of bottlenecks where they occur. In particular, policy has a role in facilitating knowledge flows across organisations and individuals where these actors do not have incentives or co-ordination mechanisms on their own to engage in such collaborations.

One of the objectives of smart specialisation policies is to prioritise a few specialisations where "relevant scale" can be built to enable networking and collective actions within and across smart specialisations (McCann and Ortega-Argilés, 2015 p. 1297). These connections are critical to path development. Grabher (1993) describes, for example, how multiple actors from industry, trade unions and the state collectively managed to break up the lock-in of the Ruhr area in Germany.

5.2. Path development in the smart specialisation areas

This section describes opportunities for industrial path development in Pomorskie. The conceptual framework for the OECD local entrepreneurship ecosystem and emerging industries case studies identifies different potential regional industrial development pathways, as indicated in Annex B. Those most appropriate for the Pomorskie smart specialisations are identified here.

Offshore, port and logistics technologies

The strong historical presence of the maritime sector in Pomorskie has led to the development of strong collaboration across a large variety of different organisations including large firms, small firms and research organisations both within and outside the region. This type of scale and history and dense networks offers great potential for entrepreneurship and diversification, as illustrated by the example given in Box 5.1 of the emergence of new activities in the optical industry in Jena, Germany.

Box 5.1. The evolution of a historic optical industry specialisation in Jena, Germany

Rationale and approach

In socialist times, the Zeiss Kombinat became the centre for the engineering of scientific instruments within the Comecon area. It had a total of 70 000 employees, 27 000 of them in Jena in east Germany. After the reunification of Germany, the restructuring of the Kombinat, and later of its successor the Jenoptik, resulted in nearly 100 new firms that emerged as spin-offs or outsourced divisions. From the original 27 000 jobs, about 10 000 remained in these new firms. During this process, the Zeiss Kombinat transformed from a hierarchically structured conglomerate into a network (Plattner, 1997). The following quote from an engineer describes this process:

"These firms are the spin-offs from the combine, foundries and so on, that in the past belonged to the combine but were dismissed. These connections continue to exist, even if they all carry their own logo, now. Nevertheless, this chain still works" (quote taken from Menzel, 2005, p. 428).

The following quote describes the conditions of mutual understanding based on common experiences and a common legacy that made these networks so efficient in the transition time and beyond:

"I worked at Zeiss for over 30 years, [a co-worker] worked at Zeiss, a further co-worker comes from Zeiss, and the people on the other side, in the small enterprises: either you knew those already, or even if you do not know them, they have this Zeiss background.... You are in accord. One understands each other" (quote taken from Menzel, 2005[21], p. 429).

Studies from other post-socialist countries have also shown that the perpetuation of networks personal relations from the socialist past were crucial to economic restructuring (Grabher and Stark, 1997) and correlated with regional economic growth (Menzel, 2005).

Relevance for Pomorskie

This case study illustrates the importance of organisations and relations that were able to persist and transform even during the phase of economic transition from the socialist economy. These dense networks are also important to the continued development of the maritime smart specialisation in Pomorskie. They can be considered as a regional asset that cannot be transferred to other smart specialisations in the region.

Source: Plattner (1997), Menzel (2005), Grabher and Stark (1997)

Highly skilled workers from the shipbuilding sector and publicly supported organisations, such as the Maritime Institute in Gdansk and the Maritime Office in Gdynia, have enhanced the specialisation of this sector resulting in an extensive collaboration of regional shipbuilding and yacht manufacturing companies with foreign partners.

The sector has benefitted from different types of entrepreneurial opportunities spotted in Gdansk, both by local individuals with experience in the sector and those from overseas. One of the luxury yacht design and manufacturing companies was founded in 2002 by a French businessman with management experience in the electric power and construction industries attracted to the region by the city's long traditions and skilled workforce in shipbuilding. Another example is a German aluminium yacht manufacturing firm originally

established in Hamburg in 1990. As a successful new company, they relocated to Gdansk in 1993 focusing on shipbuilding and offshore oil and gas. The company now has 170 employees. The former is an example of attracting an entrepreneur with management experience and relevant market knowledge. The latter is an example of an innovative start-up relocating into Gdansk. Both of them can be seen as examples of regional industrial upgrading as well as a "regional branching" into a new specialisation enabled by the local availability of skilled workers in related technological fields.

Good collaboration has also been identified between the maritime sector and other industries. For example, the Ship Design and Research Centre Co.'s (CTO) work branched out to the medical sector once the company realised that its knowledge base lies in fluidics, which is used for both shipbuilding and in medical devices. A second collaboration took place between CTO and a company rooted in the energy sector. Future cross-collaborations are envisaged in preparing the maritime sector for using the benefits of digitalisation.

The initial decline of the maritime sector led to the lay-off of workers who partially found employment in other industries while maintaining strong ties to the shipbuilding industry. These connections supported the building of networks from the maritime sector to other areas and helped the diffusion to other sectors of technologies and ideas applied in the maritime sector.

Regarding smart specialisation dynamics, the maritime sector is an example of a successfully diversifying industry. It has moved from its initial focus on shipbuilding into new areas like offshore wind farms and yacht construction. The ongoing industrial diversification reflects the structure of the network within the region. The manifold connections between the maritime and other sectors and the establishment of strong broker positions such as the CTO provide the maritime sector with the knowledge to perform these industrial diversification processes.

While this knowledge network is supporting industrial diversification processes, it may not be able provide the type of knowledge that is necessary to truly modernise the sector and position it as a logistic hub for the Baltic Sea Region (BSR). This smart specialisation process would require particular knowledge regarding digitalisation. The ICT field might provide this knowledge, and connections to this field should therefore be extended.

Interactive technologies in an information-saturated environment

The ICT specialisation in Pomorskie has evolved over time, mostly through "upgrading" the industry base by climbing GVCs and GPNs.

The backbone of the specialisation is provided by subsidiaries of multinational enterprises (MNEs) such as Intel, Amazon and Thomson Reuters that have invested in the region in recent decades. However, they are tending to focus on traditional activities while investments in future-oriented activities such as Artificial Intelligence (AI) and Machine Learning need to be promoted further.

There is a another strong anchor for the specialisation in the ICT activities of Gdansk University of Technology, which is very active in ICT training and research. In addition, there is a locally active venture capital firm focused on ICT entrepreneurship. This provides a critical mass of actors of different sizes and functions.

The smart specialisation has been successful in generating ICT spin-outs from MNEs, notably Solwit from Intel, as well as several successful new ICT start-ups. The start-ups have been successful in discovering their "entrepreneurial opportunities" from the ICT

competence base available in the region, notably including the pool of former employees of Wirtualna Polska (WP) – an internet company set up by graduates of Gdansk University of Technology that has now transferred to Warsaw.

There are some important ICT networks within the region. The former presence of WP has left a number of former staff who are well networked. There are also networks and contacts made through technology conferences (e.g. infoShare) and training (e.g. infoShare Academy coding school). ICT entrepreneurs have also been able to connect with BPO/SSC firms in the region. However, the ICT networks still tend to be outward facing and international. This reflects the connections of MNE subsidiaries with the global networks of their parent firms and the community of Polish expats in globally active ICT firms and are useful for the development of the specialisation. It may also reflect differences in capabilities between the high capabilities of the MNE operations compared with other firms and organisations in the regional specialisation which may hamper collaboration. For example, Giuliani (2007) has shown for clusters in the wine industry that regional collaboration depended on the capabilities between firms and if differences in capabilities were too large, more capable firms tended to be completely outward oriented, with no or only few connections into the cluster. More therefore needs to be done to build organisations to promote intra-regional collaboration in Pomorskie.

In addition, networks and knowledge exchange are not sufficiently strong between the ICT smart specialisation and other smart specialisations in the region. There is some collaboration between the ICT and medical technologies specialisations, notably between Medical University of Gdansk and Gdansk University of Technology and involving co-operations between ICT and health companies, although the knowledge comes purely from the ICT sector. However, ICT activities in the region could make more extensive inputs into other specialisations as well, and the collaboration between ICT and medical technologies could itself be strengthened. A key barrier for new path development in this specialisation therefore relates to a lack of connectedness to related or unrelated fields in the region. Box 5.2 illustrates the potential of an organisational infrastructure for promoting networks within and across smart specialisations and across organisations with different capabilities.

Box 5.2. The role of organisational infrastructure in networking in the Third Italy

Rationale and approach

Research on the Third Italy emerged in the 1980s, when scholars recognised that this part of the country (broadly in the north east) was developing better than expected by traditional accounts, despite being neither shaped by large industry firms, beneficial infrastructures or other location benefits. Researchers found out that what made this region outstanding were dense networks between people, firms and organisations (Becattini, 2002). These networks formed not only through a tradition of collaboration but also through a thick infrastructure of organisations, events, etc. where people from different milieus, communities and industries could meet.

While studies show that contact in spatial proximity is easier than in spatial distance (Owen-Smith and Powell, 2004), contacts are not necessarily established via pure co-location. Instead, it is due to a rich organisational setting where actors meet within the region at different events or are affiliated to the same (semi-) public organisations.

Relevance for Pomorskie

In Pomorskie, there is a lack of boundary-spanning ties and comparatively few boundary-spanning organisational forms. Studies have found a kind of organisational "thinness" in post-socialist countries in the transition phase (Grabher and Stark, 1997) and this may still be having some effects on the interface between different fields. A dense network of existing relationships can compensate for such organisational thinness, as is exemplified by the transformation of the optical industry in Jena (see Box 5.1) or the motorsport valley in Coventry (Henry and Pinch, 2001). However, in Pomorskie, only the maritime specialisation has this kind of dense network.

Sources: Becattini (2002), Owen-Smith and Powell (2004), Grabher and Stark (1997) , Henry and Pinch (2001)

Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuels, and in construction

The energy smart specialisation in Pomorskie can be seen as an example of a regional industrial pathway based on 'industry emergence' mainly through importation. It is largely based on implanting an established industry into the region, where the industry is unrelated to other existing industries in the region.

The specialisation nevertheless has a regional base in the local operations Energa, a national energy company, and the Institute of Power Engineering, which carries out research and production for the national economy with strong state participation. The national nature of these two main anchors is a potential limitation for the smart specialisation. Both Energa and the Institute of Power Engineering are strongly tied into their national knowledge exchange networks, reflecting the fact that the energy system is organised at the national level. Their ability to drive an eco-effective technologies specialisation in Pomorskie also depends critically on decisions of national state actors on how much to invest in the transition to renewable energies and where to make these investments.

The overall challenge for the regional smart specialisation is to achieve substantial growth to arrive at a critical mass in renewable energies. There is currently a lack of SMEs and

start-ups in the specialisation to create critical mass and knowledge connections and more efforts could be placed in seeking to support their development. There may also be opportunities to build connections between the energy specialisation and the maritime specialisation, for example by leveraging the networks of people who have worked in both sectors locally. Box 5.3 illustrates how such connections across sectors have been created in Esbjerg, Denmark.

Box 5.3. Knowledge exchange between offshore wind energy and offshore oil and gas specialisations in Esbjerg, Denmark

Rationale and approach

The region of Esbjerg in Denmark is a good example of how relatedness between two sectors can emerge from labour mobility. Esbjerg is home to an offshore oil and gas industry since the 1960s. An offshore wind energy cluster also emerged in the late 1990s, as wind energy firms established offices and production facilities in Esbjerg.

The two industries initially developed distinctly from each other. This appears to reflect a perception among the offshore wind energy actors that perceived they were self-reliant and able to deal with offshore installations on their own. This perception changed when damage to offshore wind farms first occurred. Those that recognised that knowledge from the oil and gas sector could help to solve the problems in the offshore wind energy sector were engineers who had previously worked in offshore oil and gas. When these multiple insiders established connections between the two fields, others followed.

Relevance for Pomorskie

This example showed that labour mobility created multiple insiders that were crucial to forming connections between the two fields. In Pomorskie, labour mobility between sectors has surely created such multiple insiders, but they do not seem to be able to create benefits at the regional level from this position.

Source: Author.

Medical technologies in the area of civilisation- and ageing-associated diseases

This smart specialisation has opportunities to follow pathways of industrial upgrading through integrating international knowledge into existing activities and actors and/or diversification through innovative start-up activities.

There are two key anchors that can lead this activity – Polpharma, a large Polish-owned pharmaceuticals firm and the Medical University of Gdansk (MUG). Both are active in supporting spin-outs and start-ups. However, start-ups from the MUG can have problems in commercialising their technologies, with a tendency to have founder teams made up principally of scientists with little business management competence. These actors are also highly internationally connected. For example, the MUG has collaborations with Pfizer and Polpharma has a range of international collaborations.

Another emerging actor in the smart specialisation is PolTreg, a successful spin-out firm from the MUG. The case of PolTreg suggests that there may be further potential for success

in spin-offs from the Medical University. In addition, PolTreg is a new potential connector for knowledge exchange in the smart specialisation. It has remained involved in both university research and industry and has recognised capabilities in both domains. It also has had globally oriented collaborations since its establishment. Furthermore, a range of actors from industry and the MUG recognise the role of PolTreg as a "multiple insider", a position that might allow PolTreg to establish further university-industry connections.

At the same time, support is needed to encourage further innovative start-ups and spin-outs, including to overcome barriers in the national entrepreneurship ecosystem with respect to start-up finance and incentives and capabilities for commercialisation of academic research. One of the constraints in this respect has been the strong focus of the MUG on basic research, whereas potential collaborations with small firms are likely to be squarely in the area of applied research.

As noted above, a further issue is that there are only a few connections between the medical technologies smart specialisation and other smart specialisations in the region. One example is the already stated collaboration between the MUG and the Gdansk University of Technology regarding ICT and health. There is potential for further related diversification as health-related topics are relevant to several fields, although the specialisation needs to first establish a coherent internal network structure to be able to provide this knowledge to other sectors.

5.3. The role of cluster organisations

In the 2007-2013 EU programming period, the Pomorskie regional government adopted a Regional Programme for Cluster Policy Support 2009-15. This helped to identify specialisations in the region and created networks of relevant research, business and government actors in the clusters. In addition, the Pomeranian Group for Cluster Competence was established in 2012, which aimed to prepare a coherent framework for cluster policy in the region and develop the competences of cluster leaders and the animators of networks and cluster initiatives.[14]

Although the majority of their public funding was stopped in the new EU programming period 2014-2020, the cluster organisations and networks have continued to function, facilitating collaboration and knowledge exchange among research, business and government in the region.[15] Representatives from the cluster organisations and groups were key players in the development of the smart specialisation strategy and participated in the EDP. They include, for example, the Pomorskie ICT Cluster, the Baltic Eco-energy Cluster and the Gdansk Construction Cluster.

The cluster organisations and leaders have the potential to offer expanded support for knowledge exchange and collective action for the smart specialisation strategy in the future. Along with others, they may play the important role of "social brokers" in the smart specialisations.

[14] Pomerania Cluster Initiatives https://ec.europa.eu/growth/tools-databases/regional-innovation-monitor/organisation/pomerania-cluster-initiatives [12/11/17]

[15] https://pg.edu.pl/cooperation/clusters [15/11/17]

5.4. Conclusions and policy recommendations

Priorities for overall regional smart specialisation conditions

Pomorskie offers examples of dense knowledge networks and strong collective actions, particularly in the shipbuilding sector, which are the result of a strong industrial legacy. However, in other activities knowledge networks still need to be built, whilst existing networks also need to be extended to new actors and initiatives. Overall, a main priority for Pomorskie then is to build connections amongst actors – within and across smart specialisations and internal and external to the region – for the purpose of strengthening knowledge exchange and collective actions. This can be achieved by promoting labour mobility, physical proximity and "social brokers" or "multiple insiders".

Labour mobility has already been a key facilitator of knowledge exchange in Pomorskie, where employees maintain relations to their previous employment fields. Initiatives to specifically promote labour mobility across key players, particularly between HEIs and SMEs, could therefore play a key role in fostering further connections. These initiatives could involve temporary hosting of university staff in industry or supporting the hiring of graduates in SMEs, as discussed in Box 5.4, in order to strengthen knowledge exchange among research and industry.

Box 5.4. Improving labour mobility through Rural Growth Pilots, Denmark

The Rural Growth Pilot (RGP) is a programme recently created under the public Danish Innovation Fund (Innovationsfonden). It is built on experiences from previous programmes that found that the recruitment of university graduates (individuals with a master's degree) had a positive impact on the growth of SMEs that did not previously have graduates among their staff. In the original overall initiative (akademikerkampagnen), the idea was simply to support SMEs and create jobs by getting graduates into SMEs. Most graduates in Denmark are hired by the public sector or large companies, and about 80% of Danish SMEs do not have a graduate employee. Yet the benefits of academic skillsets in SMEs may be quite significant. In particular, the hiring of the first academic employee was emphasised as valuable, leading to an increased likelihood of firm survival (2.2%), employee growth (4.5%) and value added (38%) over a three-year period.

The effect of the recruitment of (the first) academic is suggested to be created by the infusion of new and complementary skillsets into the SME. This is assumed to lead to innovation and productivity gains, as new ideas and perspectives emerge not only from the new skills and competences, but the meeting of the academic skills with the practical skills and experiences of the SME owners and non-academic employees. Notably, the recruitment of academics may also create an internal pressure for development and growth, which may help to create awareness of and demand for outside business development services.

In the RGP programme this idea is extended to SMEs in rural areas, where growth and innovation levels are considered lower than non-rural areas. The infusion of new skills and knowledge in the form of an academic employee is thus considered to be a possible source of innovation and growth alongside the benefit of creating new employment for academics in rural areas where academic jobs are fewer, possibly contributing to counter-urbanisation which is considered a positive policy outcome in Denmark.

The programme supports businesses by providing financial support over a period of one to two years to hire an academic. The support amounts to DKK 150 000 (EUR 20 000) per year for a maximum of two years. The support is premised on an application where the firm provides an idea for a new product, market, production method or service as well as a description of the role of the academic in the development of this. It is a requirement that the academic hire has a different skillset from the current employees.

A total of DKK 40 million (EUR 5.3 million) has been allocated to the project over a four-year period. Firms can get assistance with the development of the project and application through the local business support centre (væksthuse) and for recruitment from a network campaign designed to connect academics and SMEs.

Evaluations from similar projects suggest that the process of developing the application is manageable for SMEs, and that there is a reasonably high success rate of applications.

The RGP exemplifies some of the same design principles as the abovementioned cases, yet does so in a programme that is a specific, publicly funded and operated programme. Firstly, it directly supports a set of policy goals that are considered important in the current Danish political arena, i.e. job creation in rural areas to counter urbanisation and the creation of jobs for academics. These goals are then combined with the aim of creating SME growth. Notably, this is done in a way that is based on solid experience

from previous programmes and a carefully crafted theory of change that sees the infusion of new skills and knowledge into SMEs as a driver of innovation and growth. Furthermore, the programme has a built-in function to offset over-investment, as firms self-select into the programme. If too few companies apply to spend the full amount, they (presumably) remain in the system for other business development purposes.

Source: Author

Physical proximity – for example innovative firms, HEIs and research laboratories sharing space on science parks and incubators – also supports knowledge exchange. Many policy measures in the region are already going in the right direction. In particular, policy has supported the establishment of several business incubators and science and technology parks. However, they could increase the diversity of the actors they host. For example, the incubators might support not only young firms, but also provide places for older firms to locate within HEIs. Technology parks could also host a wider diversity of actors such as university laboratories, research organisations, specialised service providers as well as firms in different phases of their life cycle, i.e. from start-ups to producers. Additionally, co-working spaces can support knowledge exchange processes through the co-location of firms. In many respects, the O4 working space is an example which could be rolled out further, especially regarding the composition of tenants and provision of places and situations for interaction.

This section has also stressed the importance of "social brokers" and "multiple insiders" in facilitating knowledge exchange and collective action. Both individuals and organisations can take this role. Multiple insiders are important in the Pomorskie region to support not only information sharing, but also the transmission of tacit knowledge. While information sharing can take place via any form of interaction, knowledge sharing requires mutual understanding and a long-term and deep involvement into the domains of others. A priority for policy is to generate further "social brokers" and "multiple insiders" and support connections around them. In the case of Pomorskie, important steps were taken with the creation of cluster organisations under the Regional Programme for Cluster Policy Support 2009-15 and work to build the capabilities of cluster leaders. The cluster organisations and leaders have continued to operate since 2015 but without significant funding, and appropriate public support to boost to their activities could be very effective as a way of further promoting knowledge exchange within and across smart specialisations.

Another theme of this section is that there are opportunities for cross-fertilisation across the four smart specialisations that are not yet being fully exploited. An innovative technical solution can often be transferred across sectoral value chains, which may lead to the emergence of new products or the transformation of processes which had previously appeared unrelated (Andreoni, 2017). Research and innovation projects in the region should therefore not be strictly limited to projects falling within each smart specialisation. There should in addition be scope for projects that work across the smart specialisations. The regional government may also facilitate processes developing the competences of those who implement and "discover" entrepreneurial opportunities through smart specialisation, in both the private and public sectors, by collecting and sharing cross-sectoral intelligence, learning from other regional contexts, driving and delivering regional capabilities and positioning the region for the future. A consortium combining actors from all the smart specialisations would help achieve synergies.

Specific recommendations on each of the above points are provided in Box 5.5 below. In addition specific policy priorities and recommendations for each of the four smart specialisations are set out below, offering possible directions for the continuation of the entrepreneurial discovery process.

Offshore, port and logistics technologies

The maritime specialisation in Pomorskie is an example of a successfully diversifying industry with potential to modernise by integrating digital processes through cross-fertilisation with the ICT specialisation. One specific opportunity is to build connections between the maritime and ICT specialisation to promote the digitalisation of harbour logistics, but the opportunities for modernisation through digitalisation spread throughout the maritime specialisation. As well as integrating ICT from organisations within the region, there are opportunities to create better linkages with ICT specialists in the wider BSR and beyond.

Interactive technologies in an information-saturated environment

The ICT specialisation is currently on an industrial transition pathway of upgrading through climbing GVCs and GPNs. To reinforce this, it will be important to have some strong local organisations working as network hubs to build networking and interconnectedness within the smart specialisation. Policy could engage key MNEs operating in the region as anchors in developing collective actions involving the MNE and a range of SMEs and HEI partners. In addition, incubators could act as effective network hubs for collective actions and information exchange within the ICT specialisation. The way that the O4 Co-working connects a variety of actors shows a possible model to achieve this goal.

As the ICT specialisation provides important competencies for the other smart specialisations, connections to the other specialisations should also be supported. However, the connections from ICT to other fields are only likely to be successful if interconnectedness within the specialisation is also improved.

In addition, a missing link to external venture capital firms needs to be addressed for ICT start-ups and scale-ups.

Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuels, and in construction

The energy smart specialisation is seeking to develop a pathway through industry emergence involving related diversification and transformation from fossil to renewable energies. One of the obstacles is that the energy actors in the region are largely fulfilling functions at the national level and connected into national networks. This may limit the opportunities to bind the players into regional knowledge exchange and to develop a distinct regional specialisation. At the same time, smart specialisation is a long-term process and the idea is to reach competitive advantage in the long term. If this is to be achieved it will be important to build mass in the specialisation by developing more SMEs and start-ups, particularly seeking to promote entrepreneurship for industrial diversification by combining competencies in renewable energies with competencies in the other smart specialisation areas.

Medical technologies in the area of civilisation- and ageing-associated diseases

The medical technologies specialisation may follow a path of industry upgrading or diversification driven by start-ups and commercialisation of research from the MUG. It would benefit in this effort from increasing interconnectedness within the sector, especially in terms of better connecting basic and applied research. Support for labour mobility between these groups would be an important way of building these connections. An example is grants for PhD students who undertake research supervised by the University whilst located in a company. Furthermore, there are already spin-offs from the MUG that have connections both to the University and other local firms. Supporting collective projects or networking initiatives around these first movers could enhance knowledge exchange between university and industry.

In addition, regulatory and cultural barriers to entrepreneurship in the universities need to be addressed both at national higher education system and individual university strategy level in order to support the emergence of more innovative start-ups, as noted in OECD/EU (2017).

Box 5.5. Recommendations for further development of the smart specialisations

Overall recommendations

1. Enhance labour mobility between small and large firms as well as between university and industry in the smart specialisations. This can be achieved through the development of knowledge exchange partnerships, for example with industry-financed PhDs or exchange between academic and industry personnel.
2. Maintain the current co-location spaces like science and technology parks and incubators and ensure that they host a diversity of actors, such as university laboratories, professional service providers, research organisations, SMEs, and larger firms as well as young start-ups.
3. A cross-cutting consortium combining smart specialisation areas could be established to support cross-fertilisation across the smart specialisations.
4. Provide further support to the existing cluster organisations and cluster leaders relevant to the smart specialisations in order to act as "social brokers" facilitating networking and collective action among start-up and scale-up entrepreneurs, between larger and smaller companies, and between enterprises and universities.

Offshore, Port and Logistics

5. Promote modernisation by digitalisation. Encourage digitalisation by strengthening knowledge networks with other regions in ICT fields and increasing connections between the maritime and ICT smart specialisations within the region.

Interactive technologies in an information-saturated environment

6. Increase the interactions among players within the smart specialisation – including large firms, SMEs, start-ups, and HEIs – encouraging local large firms and incubators to become network hubs.
7. Facilitate the supply of risk capital to innovative ICT start-ups.

Eco-effective technologies in the generation, transmission, distribution and consumption of energy and fuel, and in construction

8. Support related diversification towards renewable energies and increase mass in the specialisation by promoting entrepreneurship in this field, particularly where it shares competencies with the region's other smart specialisations.

Medical technologies in the area of civilisation- and ageing-associated diseases

9. Stimulate greater connections between basic and applied research in the smart specialisation by supporting research projects and PhDs undertaken in companies, and supporting collective actions and networks around existing 'first mover' spin-offs in this specialisation in region.
10. Support the development of university spin-off enterprises with finance, advice, mentoring and other relevant support.

11. Increase incentives for academics to commercialise their research both at the level of the national higher education system and at the level of individual HEIs.

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Annex A. Additional statistical tables

Table A1. Local entrepreneurship ecosystem indicators by ecosystem pillar and Polish region – index values

The index score for each pillar relates to a pillar average of 1.00, high scores representing better performance. The overall index score relates to an overall average of 10.00, high scores representing better performance.

	Formal institutions	Entrepreneurship culture	Physical infrastructure	Demand	Networks	Talent	Finance	New knowledge	Intermediate services	Leadership	Overall
Dolnoslaskie	0.70	1.15	1.14	1.12	0.92	1.08	1.31	1.03	1.19	1.05	**10.68**
Kujawsko-Pomorskie	1.29	0.91	1.01	0.93	0.86	0.72	0.92	0.84	0.84	0.93	**9.26**
Lubelskie	0.93	0.80	0.83	0.90	1.52	1.07	0.78	1.01	0.98	0.88	**9.69**
Lubuskie	1.16	1.07	0.97	0.86	0.87	0.85	0.84	0.81	1.01	0.83	**9.26**
Lodzkie	0.84	0.96	1.02	1.01	0.96	0.99	1.20	1.04	0.91	0.97	**9.91**
Malopolskie	1.04	1.11	1.12	1.07	0.87	1.09	0.88	1.39	1.00	1.14	**10.71**
Mazowieckie	0.80	1.44	1.13	1.56	0.84	1.62	0.79	1.52	1.54	1.56	**12.79**
Opolskie	1.33	0.75	1.06	0.84	1.08	0.87	1.05	0.79	0.89	0.90	**9.56**
Podkarpackie	0.83	0.80	0.94	0.90	1.43	0.91	0.94	1.34	0.83	1.10	**10.01**
Podlaskie	1.19	0.81	0.81	0.93	0.99	1.11	1.01	0.97	0.95	0.84	**9.52**
Pomorskie	**1.17**	**1.27**	**1.01**	**1.00**	**0.93**	**1.05**	**0.98**	**1.21**	**1.10**	**1.00**	**10.74**
Slaskie	0.70	0.89	1.37	1.23	0.93	0.97	0.86	1.01	0.99	1.12	**10.08**
Swietokryzskie	0.89	0.86	0.87	0.84	0.98	1.01	1.48	0.86	0.74	0.87	**9.40**
Warminsko-Mazurskie	1.10	0.85	0.84	0.85	0.84	0.81	0.96	0.87	1.12	0.80	**9.02**
Wielkopolskie	0.95	1.12	1.02	1.15	0.89	0.95	0.82	1.01	0.73	1.17	**9.81**
Zachodniopomorskie	1.06	1.20	0.874	0.91	1.08	0.92	1.18	0.83	1.19	0.83	**10.08**

Source: Own elaboration, see Table 2.5 for data sources

Table A2. Local entrepreneurship ecosystem indicators by ecosystem pillar and Polish region – rankings

	Formal institutions	Entrepreneurship culture	Physical infrastructure	Demand	Networks	Talent	Finance	New knowledge	Intermediate services	Leadership	Overall
Dolnoslaskie	16	4	2	4	10	4	2	6	2	6	**4**
Kujawsko-Pomorskie	2	9	9	8	14	16	10	13	13	9	**15**
Lubelskie	10	15	15	11	1	5	16	9	9	11	**10**
Lubuskie	5	7	10	12	12	14	13	15	6	15	**14**
Lodzkie	12	8	6	6	7	8	3	5	11	8	**8**
Malopolskie	8	6	4	5	12	3	11	2	7	3	**3**
Mazowieckie	14	1	3	1	16	1	15	1	1	1	**1**
Opolskie	1	16	5	14	3	13	5	16	12	10	**11**
Podkarpackie	13	14	11	10	2	12	9	3	14	5	**7**
Podlaskie	3	13	16	16	5	2	6	10	10	13	**12**
Pomorskie	**4**	**2**	**8**	**7**	**8**	**6**	**7**	**4**	**5**	**7**	**2**
Slaskie	15	10	1	2	8	9	12	8	8	4	**6**
Swietokryzskie	11	11	13	15	6	7	1	12	15	12	**13**
Warminsko-Mazurskie	6	12	14	13	15	15	8	11	4	16	**16**
Wielkopolskie	9	5	7	3	11	10	14	7	16	2	**9**
Zachodniopomorskie	7	3	12	9	4	11	4	14	2	14	**5**

Source: Own elaboration, see Table 2.5 for data sources

Table A3. Regional Strategic Programmes Under the Pomorskie 2020 Regional Development Strategy

Name of regional strategic programme	Associated operational objectives (from Pomorskie 2020)	Associated directions of action (from Pomorskie 2020)
Pomorskie Creativity Port	High performance of enterprises	• Diffusion of innovation in enterprises and transfer of knowledge to the economy • Support for cluster initiatives and projects implemented by clusters • Support for foreign expansion of enterprises • Attraction of FDI
	Competitive higher education	• Access to broadband internet, including very high bandwidth networks • Internationalisation of HEIs and export of educational services • Cooperation between HEIs in the region • Collaboration between HEIs and employers to improve the quality of education • Support for sub-regional centres for vocational education
Pomorskie Travel	Unique tourist and cultural offer	• Development of networking and comprehensive tourist products • Creation of a recognisable, high-quality cultural offer
Active Pomeranians	High level of employment	• Activation of the economically inactive and unemployed • Support for development of micro- and small enterprises • Improvement of the quality of upper-secondary vocational education and lifelong learning
	High level of social capital	• Systemic strengthening of the capacity of NGOs • Raising the level of regional and local identity and integration of local communities • Active participation in culture, sports and recreation • Comprehensive revitalisation and development of public spaces
	Effective educational system	• Ensuring high-quality education at the primary, lower secondary and higher secondary level • Improving access to primary education and organised forms of childcare for children up to 3 years

		• Development of systematic support for pupils with special educational needs (including high achievers)
Health for Pomeranians	Better access to health services	• Improved access to high-quality health specialist services in the field of civilisation diseases • Intensification of prevention and diagnostic activities in the field of civilisation diseases
Mobile Pomorskie	An efficient transport system	• Development of public transport systems • Development of the road network linking county towns with their surroundings and the Tri-City area • Modernisation of infrastructure linking multimodal nodes with the transport system in the region
Eco-effective Pomorskie	Energy security and efficiency	• Support for energy efficiency projects • Support for projects related to the use of renewable energy sources • Development of heat supply systems and increasing the range of their service • Changing local and private sources of energy to reduce emissions of pollutants
	Good environmental conditions	• Development of collection and treatment systems for wastewater, rainwater and snowmelt • Reduction of flood risk • Development of comprehensive municipal waste management systems • Preservation of wildlife and improvement of natural cohesion • Development of environmental and flood risk monitoring

Source: Pomorskie 2020, http://strategia2020.pomorskie.eu/rps-pomorski-port-kreatywnosci.

Annex B. Framework for regional path development opportunity assessment

The OECD case studies on Local Entrepreneurship Ecosystems and Emerging Industries include a framework that identifies a different industrial path development opportunities for regions and the most appropriate industrial development pathways for policy to promote based on the region's pre-conditions. The framework, based on Grillitsch (2018), is applied to the regional case studies to guide assessment of the potential for emerging industries in the region and the key policy thrusts needed. The framework also helps assess the relevance of the smart specialisation priorities chosen by case study regions adopting smart specialisation strategies.

Typology of industrial path development

The path development opportunities identified in the framework range from 'path upgrading', normally taken care of by industry itself in the short and medium term, to 'path diversification' and 'path emergence'. The latter represent transformative activities, which require long-term policy and planning as they represent a jump in novelty and knowledge complexity and therefore also require broader co-operation between industry, universities and governmental agencies on multiple scales (regional, national and international).

Table A.4 summarises the main types of regional industrial path development. It illustrates the various forms of new path development that are on the table for policy makers and highlights which resources are required to achieve the various outcomes, from where the resources can be sourced and the outcome of the various forms of new path development.

Table A.4 Types and mechanisms of regional industrial path development

Types	Mechanisms
Path upgrading	
I - Climbing GPN	Major change of a regional industrial path related to enhancement of position within global production networks (GPNs); moving up the value chain based on upgrading of skills and production capabilities
II - Renewal	Major change of an industrial path into a new direction based on new technologies or organisational innovations, or new business models
III - Niche development	Development of niches through the integration of symbolic knowledge
Diversification	
I - Related	Diversification into a new related industry for the region building on competencies and knowledge of existing industries (regional branching)
II -Unrelated	Diversification into a new industry based on unrelated knowledge combinations
Emergence	
I - Path importation	Setting up of an established industry that is new to the region (e.g. through non-local firms) and unrelated to existing industries in the region
II - Path creation	Emergence and growth of entirely new industries based on radically new technologies and scientific discoveries or as an outcome of search processes for new business models, user-driven innovation and social innovation

Source: Grillitsch, (2018); Grillitsch, Asheim and Trippl, (2017)

Regional pre-conditions for industrial path development

The path development types that a region is best placed to pursue depends on its regional industry pre-conditions. The framework classes these pre-conditions on two dimensions – the sophistication of the regional innovation system and the industrial diversity of the region.

Sophistication of the regional innovation system

The assessment of the sophistication of the regional innovation system is based on three fundamental system properties: actors, networks and institutions. Table A.5 outlines the main features characterising a sophisticated regional innovation system.

Table A.5 Sophistication of systems of innovation and entrepreneurship

System elements	Indicators of sophistication
Actors	
Capabilities	Use of cutting-edge knowledge & technologies; high resource endowment and financial capabilities; prominent positions in global production and/or innovation networks
Variety of types	Actors presenting large parts of the value chain as well as complementary organizations in the fields of research, education, finance, technology mediation, incubators, public administration, etc.
Scale	Number and size of organizations and entrepreneurs
Networks	
Within sectors	Density of innovation and production networks within value chains
Between sectors	Bridging social capital, existence of collaborations, networks between industries, as well as between industry, research, governance (triple helix) and civil society.
Local-global	Combination of linkages at the local and global scale
Institutions	
Quality of governance	Low corruption, impartial public services and rule of law
Adequate policy repertories	Adaptation of the support system to the region-specific needs and opportunities
Governance process	Involvement of actors at multiple-scales (local, regional, national, international) and of different sectors; interplay between bottom-up and top-down policy making
Entrepreneurial culture	Low risk aversion, high rate of entrepreneurship, new firm formation

Source: Grillitsch, (2018)

Industrial diversity of the region

Another dimension of the pre-conditions for industrial path development is the relative specialisation or diversification of the regional economy.

Specialisation in one industry can be understood as a cluster (Porter 1998, 2000) with strong traded and untraded interdependencies between related firms and organisations (Storper 1995). Storper et al. (2016) also distinguish between specialisation in growing and dynamic industries versus specialisation in mature and declining industries. The former are the major source for superior economic growth in core regions. As industries mature,

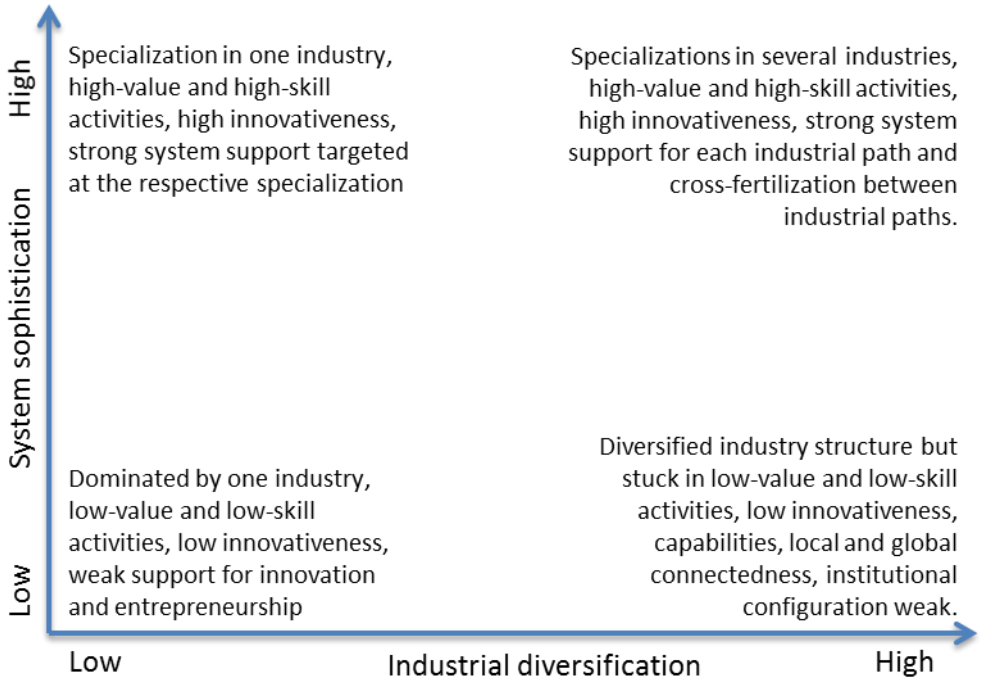
lower-skilled production relocates to more peripheral regions. Also, industrial diversification is typically not a top policy priority if regions are specialised in a dynamic and growing industry. In contrast, industrial diversification and renewal is the main policy objective in stagnating regions with a specialisation in older industries (Hassink 2010; Trippl and Otto 2009).

There are two different types of industrial diversity on which regions can vary. Related variety refers to the opportunities for inter-industry spillovers between sectors that draw on similar knowledge about technology, markets, etc. (Content and Frenken, 2006). This supports firms to diversify into technologically related products. Unrelated variety, in contrast, refers to industries that do not share similar knowledge. The combination of unrelated knowledge is thought to be of high importance to more radical industrial path development in a region (Grillitsch, Asheim and Trippl 2017; Boschma et al. 2017).

Characterisation of different types of regional pre-conditions

The opportunities for regional policy to promote the different types of industrial pathways are affected by the position of the region on the dimensions of system sophistication and industrial diversification. Figure A.1 presents a categorisation of regional preconditions on these dimensions. The Figure recognises however that variation on these dimensions is continuous.

Figure A.1 Representation of types of regional pre-conditions



Source: Grillitsch, (2018)

Regional opportunities for industrial path development

Table A.6 provides a characterisation of the most promising forms of industrial path development in regions using the path development typology of Table A.4 and the system sophistication and diversity categories of Table A.5.

Table A.6 Regional barriers and opportunities for industrial path development

Major Opportunities and Barriers	Low system sophistication	High system sophistication	
		Low industrial diversification	**High industrial diversification**
Most promising forms of industrial path development	Path importation and path upgrading	Related and unrelated diversification	Related and unrelated diversification New path creation
Barriers to develop new growth paths	Low capabilities of actors Peripheral position in global innovation and production networks	Homogeneous knowledge base Limited networks outside the field of specialisation	Lack of networks between industries and sectors Lack of exploitation capacities
Barriers to break with existing industrial paths	Potential monopolisation of networks and policies through key firms	Pervasive lock-in due to existing specialisation (political, functional, cognitive)	Potential barriers to reallocating resources to new industrial paths

Source: Grillitsch (2018) and Grillitsch and Trippl (2016)

Policy for industrial path development in regions with diversified industry, high innovation capacity, and high system diversification can be seen to have greater probabilities of favouring new path development, whereas those with specialized industry, low innovation capacity and low system diversification have greater probabilities of being able to achieve more modest path extensions.

Implications for regional industrial path development policy

The framework suggests that regional industrial path development policies should seek to support the most promising industrial pathways in a region based on its regional preconditions, and focus on addressing the typical barriers to path development in these contexts. Table A.7 characterises the main regional policy options for industrial path development based on this framework.

Table A.7 Regional barriers and opportunities for industrial path development

Main policy features	Low system sophistication	High system sophistication	
		Low industrial diversification	High industrial diversification
Overall Objective:	Gain strong position in a niche and increase system sophistication	Move towards more dynamic industrial growth paths	Move towards more dynamic industrial growth paths and create new industrial growth paths
Actors:	• Strengthen skills and competencies of local actors in relation to a niche	• Strengthen skills and competencies in complementary fields • Attract new players	• Support actors to build competencies relevant for dynamic industrial paths • Increase capacities to commercialize research-based knowledge (locally or through inflow of external actors)
Networks:	• Strengthen networks within GPN • Strengthen global networks with universities and other knowledge providers	• Promote global networks with related industries • Promote global networks to sources of unrelated knowledge in research and industry • Break self-sustaining coalitions between incumbents and policy makers	• Increase regional connectedness between industries and sectors
Institutional and organisational support:	• Provide training, education, and capacity building to local actors • Promote "global mindedness" • Facilitate access to resources and support structures available in core regions • Enhance attractiveness (incentives for inflows of individuals and organisations)	• Encourage regional visioning for diversification towards new growth paths • Reorient cluster, entrepreneurship, and innovation policy from supporting existing to developing new industrial paths (including reallocation of public resources) • Introduce / strengthen education and training in complementary fields • Facilitate access to finance and other general capabilities available in core regions	• Provide all core resources and generic capabilities for innovation and entrepreneurship locally (targeting bottlenecks and enhancing connectedness) • Removing barriers for interactions and mobility between sectors • Create or promote platforms that connect industries and sectors • Shift public support and resources from established low-growth paths to new, dynamic industries

Source: Grillitsch (2018) and Grillitsch and Trippl (2016)

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