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Peer Review

Poland's Higher Education and Science system

Horizon 2020 Policy Support Facility

Research and Innovation

Peer Review of Poland's Higher Education and Science System

European Commission
Directorate-General for Research and Innovation
Directorate A — Policy Development and Coordination
Unit A4 — Analysis and monitoring of national research and innovation policies

Contact (H2020 PSF Peer Review of Poland):
Diana SENCZYSZYN, Coordinator of the Peer Review, Unit A4 - Diana.SENCZYSZYN@ec.europa.eu
Román ARJONA, Chief Economist and Head of Unit A4 - Roman.ARJONA-GRACIA@ec.europa.eu

Contact (H2020 PSF coordination team):
Román ARJONA, Chief Economist and Head of Unit A4 - Roman.ARJONA-GRACIA@ec.europa.eu
Stéphane VANKALCK, PSF Head of Sector, Unit A4 - Stéphane.VANKALCK@ec.europa.eu
Diana SENCZYSZYN, PSF Team Leader, Unit A4 - Diana.SENCZYSZYN@ec.europa.eu

RTD-PUBLICATIONS@ec.europa.eu
European Commission
B-1049 Brussels

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EUROPEAN COMMISSION

Peer Review

Poland's Higher Education and Science System

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Written by the independent panel of experts and national peers

National peers

Göran Marklund (Sweden)

Christian Naczinsky (Austria)

Ward Ziarko (Belgium)

Independent experts

Georg Winckler (chair, Austria)

Jaana Puukka (rapporteur, Finland)

Jon File (Netherlands)

Lauritz B. Holm-Nielsen (Denmark)

Göran Melin (Sweden)

Directorate-General for Research and Innovation

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Table of Contents

List of Tables

List of Figures

ABOUT THE PSF PEER REVIEW EXPERT PANEL

Georg Winckler, chair (Austria): an Austrian economist. From 1999 to 2011, Georg was rector of the University of Vienna and, from 2000 to 2005, chairman of the Austrian Rectors' Conference when Austria's 2002 reform law for universities was designed and implemented. From 2005 to 2009, he was president of the European University Association (EUA). From 2004 to 2007, he was a member of the European Research Advisory Board (EURAB) and, from 2008 to 2012, a member of the European Research Area Board (ERAB) at the European Commission. Since February 2012, he has been chairman of the board and president of the association of the ERSTE Foundation, a member of the Board of Trustees of the Educational Testing Service (ETS) in Princeton/US since 2009, and a member of the University Board (Universitätsrat) of the University of Vienna since 2013.

Jaana Puukka, rapporteur and expert (Finland): independent policy analyst and government adviser in higher education and innovation policy. Jaana is a former Organisation for Economic Co-operation and Development (OECD) analyst in the OECD Education and Skills Directorate (2005-2013) where she led higher education system evaluations in over 30 countries, focusing on regional development. She was, for example, the lead evaluator and the rapporteur of the review in Poland which analysed the performance and relevance of universities in terms of their contribution to socio-economic development in Wrocław and Lower Silesia, and examined the underpinning national higher education and science policies. In 2013, she established a boutique consulting agency in France (Innovation Engage). Jaana is an external expert of the ET2020 OMC Working Group on Modernisation of Higher Education (since 2013), a core expert for the University-Business Forum (since 2016), a rapporteur for Horizon 2020 Advisory Group on Spreading Excellence and Widening Participation (since 2014), a member of the network of independent education experts for Directorate-General EAC (2014-2016), and board member of the EIESP.

Jon File, expert (Netherlands): Director of Development and Consultancy at the Centre for Higher Education Policy Studies (CHEPS) at the University of Twente, in the Netherlands. He is an expert in higher education system dynamics, planning and policy, notably in developing and transitional economies. Jon was the co-project leader of the recently completed study on structural reforms in higher education in EU and is a senior member of the project on promoting the relevance of higher education, both carried out for DG EAC. He has been an expert member of OECD reviews on the higher education systems of Portugal and the Czech Republic.

Lauritz B. Holm-Nielsen, expert (Denmark): Executive Director of the Sino-Danish Center (SDC), Beijing. He was the rector of Aarhus University from 2005-2013, and is a high level advisor to the Senior Management Group at Aarhus University; chairman of the Danish National Fund for Nature; president of EuroScience, Strasbourg; and a member of the Governing Board of Gothenburg University, Sweden. As rector for the Danish Research Academy (1986-93), Lauritz was in charge of reforming research training in Denmark and introducing PhD programmes in Denmark´s research universities. He was global lead specialist for higher education, research and innovation at the World Bank 1993-2005. He was a member of the Danish Prime Minister's Growth Forum, chairman of the Science Research Council and of the national committee for research infrastructure, vice-chairman of the Danish Research Commission (White Paper), vice-president of the European University Association (EUA), chairman of the Nordic Academy for Advanced Study, and the Nordic University Cooperation, and a member of several OECD expert review teams and other international review and advisory panels on higher education and research.

Göran Marklund, peer expert (Sweden): Deputy Director General and Head of Operational Development and Analysis at Vinnova, the Swedish Innovation Agency. In that capacity, he is engaged in developing Vinnova's strategy and programme designs. Göran is also actively engaged in developing the agenda of the OECD TIP, Working Group on Innovation and Technology Policy. He has been associate professor in economic history at Uppsala University, with a focus on innovation and economic change; and science and technology attaché at the Swedish Embassy in Washington DC and guest researcher at the Centre for International Technology Policy (CISTP) at George Washington University. He regularly gives advice to the Swedish government and the EU on research, innovation and growth policy issues. As a researcher, Göran has specialised primarily in globalisation, innovation and national competitiveness, as well as policy impact studies, with a particular focus on R&D and innovation indicators. In this function, he has closely followed the OECD's and Eurostat's indicator work and assisted at meetings of the OECD's group of national experts of science and technology indicators, NESTI. He is currently chairman of the Advisory Board for R&D and Innovation Statistics at Statistics Sweden.

Göran Melin, expert (Sweden): Associate Professor at Stockholm University and Assistant Director at Technopolis Group Sweden. He has conducted studies and evaluations for ministries/governmental authorities and higher education institutions in Sweden, Denmark, Finland, Czech Republic, Lithuania, Norway and the UK, targeting issues such research-funding mechanisms, organisation of higher education institutions, mobility, doctoral training, alliances and mergers between higher education institutions, academic careers and cooperation between universities and the surrounding society. Matters related to participation in the EU Framework Programmes have repeatedly been in focus. In 2011–2012, he supported DG EAC's Thematic Working Group of Higher Education as an expert. He also has experience as a national expert in a CREST OMC Working Group ('Mutual learning on approaches to improve the excellence of research in universities', 2009).

Christian Naczinsky, peer expert (Austria): Head of Department, EU Research Policy and Coordination, Ministry for Science, Research and Economy since 2002. Former Deputy Director General for Research and chief coordinator of the Austrian EU Council Presidency in the field of research. Among other posts, Christian is currently a member of the Austrian delegation to OECD CSTP, head of the Austrian delegation to ERAC, sherpa to the Austrian Director General in the Research Policy Group, chair of the Austrian ERA Reporting Board, chair of the Austrian Roundtable for Delegates to Horizon 2020, chair of the steering boards of the Austrian Research Promotion Agency (FFG) for European and

International Programmes as well as EU-Performance Monitoring, secretary of the ERA Council Forum Austria and co-chair of the Austrian Working Group on the OECD Review of Austria's STI eco-system.

Ward Ziarko, peer expert (Belgium): director of the Belgian Science Policy Office (Belspo) and adviser (STI-indicators and science policy monitoring) 1986-2012. He is a member of OECD working parties (NESTI, CSTP, TIP), EU working parties (ERAC), and member of the Eurostat working party on STI indicators. In Belgium, Ward is a member of CFS-STAT and CIS-CFS, and previously lead the ERAC ad-hoc working group on the European Semester and ERA monitoring.

PSF team leader (observer, European Commission): Diana Senczyszyn, policy officer

PSF contractor (project manager, Technopolis Group): Jacek Walendowski

The PSF contract is implemented by the Technopolis Group, in partnership with Manchester Institute for Innovation Research (MIOIR) and the Centre for Social Innovation (ZSI), along with a network of 48 associated institutions, companies and experts.

KEY POLICY MESSAGES

Poland is continuing its transition towards an open and globally competitive economy. It is aiming to reinforce its position on a European scale as a large and growing knowledge-based economy. An efficient higher education (HE) and science system is at the nexus of knowledge creation, education, innovation and economic growth. Despite past efforts to transform Poland's HE and science system, its performance and innovation outcomes remain sub-optimal. The government has therefore embarked on a new process of reform, the successful implementation of which is a prerequisite to achieving the country's goals. Designing and implementing these reforms successfully will require one or two decades of continuous and consistent efforts.

There are three guiding principles for the reform:

- **Review the education and training of human capital and the career structures in Poland's HE and science sectors**.

- **Develop a lean legal framework for HE and research systems with a view to improving the institutional capacity for change**, as well as strengthening autonomy and accountability.

- **Ensure quality, relevance and critical mass in HE, science and innovation**. This requires a new career system and rigorous selection based on transparent criteria among research projects and teams applying for support. It also needs stakeholder and research end-user involvement in defining research priorities, adequate levels of sustainable funding and the concentration of resources in priority areas.

The seven key messages of the review:

MESSAGE 1. Develop a strong performing higher education and science system through a carefully designed consolidation process with the aim of creating a binary higher education system with robust universities of applied sciences and university sectors. The fragmentation of research capacity across universities, public research institutes and the Polish Academy of Sciences (PAN) should be reduced by the incorporation of well-performing public research and academy units into research-intensive universities.

Successful modern mass HE systems are characterised by a high level of institutional diversity in which individual institutions have different missions and profiles. Poland's HE system needs more diversity in institutional missions, particularly in terms of internationally competitive research-intensive universities, and a robust and dynamic vocational HE sector. The university sector should include a group of (about 10) research-intensive universities competitively selected for an excellence programme of significant additional multi-year funding. After the first funding period, a further competitive selection process could lead to a small number of flagship universities (about three) and these should receive increased additional multi-year funding. The HE system would also benefit from moving away from a system characterised by a large number of specialised higher education institutions (HEIs) to larger more comprehensive institutions.

MESSAGE 2. Ensure effective governance and regulation. Facilitate the development of sufficient, professional and executive leadership in public higher education institutions in line with their profiles.

Modern complex institutions cannot be governed effectively and exploit the benefit of autonomy without leadership that satisfies external demands for accountability as well as the need for collegial influence. This implies strengthening institutional autonomy but balancing it with accountability through three key actions: (i) strengthening the power of executive management within institutions, including appointed leadership and management; (ii) reducing the power and influence of collegial bodies; and (iii) establishing governing bodies with external stakeholders in all types of higher education institutions.

MESSAGE 3. Introduce a public investment target for the higher education and science and innovation system and a multi-annual budgeting system for higher education institutions.

Design a sustainable financing strategy aligned with the long-term strategic goals, keeping in mind that the shape and institutional configuration of the HE system will largely determine the cost of operating HEIs and that the reform will require fresh sustainable funding in the system. Underpin the long-term commitment to HE and science and innovation with a sustainable financial expansion plan, mobilising both public and private resources to meet the needs for quality improvement, system configuration and R&D expansion. In so doing, the government needs to ensure that the design and operation of funding mechanisms are transparent and the different instruments are compatible. To steer such a system, the government could also introduce performance agreements.

MESSAGE 4. Enhance the quality of the higher education and science and innovation system by radically reforming the doctoral training and academic career system.

In order to generate state-of-the-art research competences, develop institutionalised (national) doctoral programmes or doctoral schools in line with international best practice. In addition, reform the academic career system to attract, nurture and retain talent, and to ensure that those in the HE and science system are encouraged to fully utilise their potential throughout their career.

MESSAGE 5. Enhance the adoption of sound evaluation practices and a quality culture to support the diversified higher education and science system. This should be based on a lean, effective and transparent system of quality assurance and evaluation for higher education and science built on the following principles: (i) simplify the quality assurance system architecture; (ii) align the system with international

standards to enhance excellence and reduce state control; and (iii) improve transparency and openness.

Regular external evaluation of publicly funded programmes and institutions – with international participation – should cover all parts of the HE and science and innovation system. Evaluation should be firmly embedded in the policy cycle so that results would feed back into subsequent rounds of support and policy design.

MESSAGE 6. Ensure a broad approach to innovation through universities' third mission and system linkages, by stimulating academic and student entrepreneurship and third-mission activities based on cooperation between universities and industry, as well as with the public sector and civil society.

HE and academic research are vital for competitive innovation capabilities but investments in the science base alone is not enough to guarantee innovations or societal and economic returns. In order to improve the national innovation performance and the relevance of university research and education, greater efforts should be made in knowledge exchange based on an interactive and long-term relationship between universities, industry and the wider community. Invest in developing university-industry learning environments which: (i) support the skills and human capital development required to adopt and apply process and product innovations, (ii) work with SMEs as well as large corporations and (iii) measure success in terms of the sustainability and transformation of industry and employment growth.

MESSAGE 7. Develop a broad-based internationalisation strategy for Poland that sets out clear orientations and actions to promote the internationalisation of Polish science and innovation, mainstreaming internationalisation in existing policies, programmes and institutions.

This strategy should facilitate the circulation of foreign and national students (as well as 'internationalisation at home' to ensure that non-mobile students and staff will also benefit), secure adequate public investment to support the internationalisation of R&I activities, and encourage public R&I institutions to put in place the necessary support mechanisms to increase their participation in international networks, including through better science-business links.

EXECUTIVE SUMMARY

This summary outlines the rationale behind the policy messages proposed by the review team to redress Poland's higher education and science system's structural weaknesses and build on its existing and potential strengths. To develop these messages, the review team has taken advantage of its expertise in higher education (HE) and research and innovation (R&I) policy formulation, implementation and evaluation and good practice applied in the Member States and OECD countries.

THE HIGHER EDUCATION AND SCIENCE LANDSCAPE REFORM (Chapter 3)

MESSAGE 1. Develop a highly performing higher education and science system through a carefully designed consolidation process with the aim to create a binary higher education system with robust university of applied sciences and university sectors. The fragmentation of the research capacity across universities, public research institutes and the Polish Academy of Sciences (PAN) should be reduced by the incorporation of well performing public research and Academy units into research-intensive universities.

Successful modern mass higher education systems are characterised by a high level of institutional diversity in which individual institutions have different missions and profiles. Poland needs more diversity of institutional missions particularly in terms of internationally competitive research-intensive universities and a robust and dynamic vocational higher education sector. The university sector should include a group of (about 10) research-intensive universities competitively selected for an excellence programme of significant additional multi-year funding. After the first funding period a further competitive selection process could lead to a small number of flagship universities (about 3) and these should receive increased levels of additional multi-year funding. The higher education system would also benefit from moving away from a system characterised by a large number of specialised higher education institutions to larger more comprehensive institutions.

To enhance the diversification and profiling of higher education institutions (HEIs), the panel proposes to strengthen a group of research-intensive universities, with a flexible policy instrument which is easy to adapt to changing circumstances. The panel proposes an approach based on the German Excellence Initiative, a competition to select a small number of (perhaps 10) research-intensive universities with a very high potential for excellent research, and providing them with significant additional multi-year funding. In a second stage, towards the end of the first funding period, an international peer review could select a small number of (perhaps three) internationally competitive flagship universities from within those selected for the excellence programme. Flagship universities would receive higher levels of additional multi-year funding. Delaying the selection of flagship universities also allows for a period of potential institutional reconfiguration in terms of consolidating the HE landscape reform.

A major shortcoming of the Polish HE system is the underdevelopment of vocational HE. Classifying institutions as teaching institutions will not in itself create strong and attractive vocational HE with career-focused programmes connected to labour-market needs and modern approaches to teaching and learning. **The panel's view is that the creation of a modern university of applied sciences (UAS) sector is the structural reform needed to achieve these objectives**. The development of this new sector should be the target of a major funding programme and it should aim to enrol a significant proportion of HE students (around 20 %) over the next decade.

Key to establishing and maintaining a successful diversified HE system are mission-differentiated governance, funding, human resource management and institutional evaluation and accreditation criteria. These differentiated policies should be developed and implemented. To ensure that institutions will see benefits for themselves, the new funding to be injected into the system must be allocated very carefully. If institutions are expected to diversify their missions, they require diversity in funding. Resources are needed for excellent research, applied research and development, developing innovative teaching and learning approaches, and stimulating the role of HE in regional development.

In terms of **institutional consolidation**, a consolidation process coordinated by the Ministry of Science and Higher Education, Poland (MNiSW) should be initiated **based on financially supported voluntary mergers** within a framework of clear goals for the landscape reform. The primary consolidation target should be large cities which concentrate most public HEIs (79 of 89 public institutions excluding higher vocational schools and specialised academies of other ministries) with a consolidation strategy to move from a large number of broadly/highly specialised institutions to a smaller group of more comprehensive universities. Mergers will help to create stronger more sustainable institutions and a more 'steerable' system and should be supported by adequate 'merger support funding'.

A significant part of Poland's public research, development and innovation capacity is outside of the university sector. The 114 public research institutes employ more than 12 000 researchers while the Polish Academy of Sciences' 70 research institutes are home to 8000 researchers. By relocating strong research units into research-intensive universities, Poland could raise the international visibility of Polish science and improve the performance of its universities in the global rankings.

The panel proposes the incorporation into the universities of the best performing (A+ and A category) research institutes and the institutes of the Polish Academy of Sciences (PAN). Denmark undertook a similar restructuring of public research institutes in 2007. The mode of incorporation and the most suitable host-university should be considered on a case-by-case basis. In the case of research institutes, care should be taken to ensure that incorporation into universities does not harm the market positions and industry collaboration of the research institutes, but will instead enrich the universities' graduate education and third-mission activities. The remaining research institutes and the PAN institutes should be incorporated into the proposed

Research Network Lukasiewicz (originally proposed as a national institute of technology, NIT), or also in universities, thus **making the PAN a distinguished scientific society** rather than a research-performing organisation in competition with universities and the planned research network organisation. **Powers to award doctoral degrees should be invested in the universities**.

THE DEVELOPMENT OF GOVERNANCE, FUNDING, HUMAN RESOURCES AND EVALUATION (Chapter 4)

A diversified HE system requires mission-differentiated governance, funding, human resource management, and institutional evaluation and accreditation criteria. The following key messages are mainly substantiated by reference to research-intensive universities, the development of which is the key goal of HE reform to enhance international visibility.

The key message for governance

MESSAGE 2. Ensure effective governance and regulation.

Facilitate the development of sufficient, professional and executive leadership in public HE institutions in line with their profiles.

Modern complex institutions cannot be governed effectively and exploit the benefit of autonomy without leadership that satisfies external demands for accountability as well as the need for collegial influence. This implies strengthening institutional autonomy but balancing it with accountability through three key actions: (i) strengthening the power of executive management within institutions, including appointed leadership and management; (ii) reducing the power and influence of collegial bodies; and (iii) establishing governing bodies with external stakeholders in all types of higher education institutions.

The potential of Poland's HE and research is hampered by the public university governance system due to legal constraints, institutional inertia and over-regulation. Public HEIs – with the exception of higher vocational schools – lack direct involvement by external stakeholders in their governance. It is this lack of external influence that drives inward-looking institutions which tend to focus on supply-driven education and research and development (R&D). None of the public universities has exercised the right to appoint rectors, but they continue to elect or select rectors and deans *primus inter pares*. Although rectors have the formal responsibility for their institutions, their ability to exercise effective leadership is *de facto* limited. The governance system, the mechanical internal budget allocation and the distribution of research funding to the scientific units are all contributing to the internal fragmentation of universities, reducing their ability to steer change.

Poland's HE and science and innovation policy requires a systemic and strategic approach to reduce policy fragmentation and foster critical mass. Effective governance includes co-ordinating the policies influencing HE and innovation performance and the horizontal and vertical co-ordination of government. The quality of governance in universities and public research organisations – the major pillars of the innovation system – is critical.

HE institutions should be allowed to organise a well-balanced governance structure in which the leadership is conducted with checks and balances both externally (society, industry), and internally (faculty, staff and students) in line with their profile. External stakeholder participation should be mandated in all HEIs, reflecting their mission and profile. The governing board with (a majority of) external board members should select and appoint the rector, decide on the institutional strategy based on a proposal presented by the rector, decide the budget and sign the statement of accounts. The board should also have regular insight into the institution's general matters and strategy, operating as a sounding board for the rector and senior management team so as to increase transparency and trust between Polish society at large and the university community.

In addition to suboptimal governance arrangements, Polish HEIs are also constrained by over-regulation, partly linked to the ministry's multiple minor funding streams, each of which implies detailed reporting responsibilities. This generates a significant burden on institutions and may reduce their interest in and ability to contribute to innovation and institutional reforms. The ministry should investigate and reduce the extent of the current regulatory burden on HEIs in order to save time and money. There is also a need to estimate the potential costs of accountability related to the new governance systems being planned, in order to identify and quantify the main sources and extent of burden as well as seeking improvements by data sharing and a risk-based approach to quality assurance.

The key message for funding

MESSAGE 3. Introduce a public investment target for the higher education and science and innovation system and a multi-annual budgeting system for higher education institutions.

Design a sustainable financing strategy aligned with the long-term strategic goals, keeping in mind that the shape and institutional configuration of the HE system will largely determine the cost of operating HEIs and that the reform will require fresh sustainable funding in the system. Underpin the long-term commitment to HE and science and innovation with a sustainable financial expansion plan, mobilising both public and private resources to meet the needs for quality improvement, system configuration and R&D expansion. In so doing, the government needs to ensure that the design and operation of funding mechanisms are transparent and the different instruments are compatible. To steer such a system, the government could also introduce performance agreements.

The rationale for the reform and consolidation of the HE and science system is supported by the need to address current underfunding and inefficiencies in funding allocation and spending. These inefficiencies relate to the system fragmentation, leading to a potential waste of public resources. While the financial advantages of consolidation may accrue in the longer term, it will improve the steering of the system with more efficient allocation and use of public resources. **Additional funding should be linked to reforms and improvements in the performance of institutions.**

A key step is to introduce an investment target with multi-annual budgets for efforts in the HE and science and innovation system, accompanied by the necessary reforms to improve the system's quality and efficiency. Poland's HE, science and innovation system needs the predictability of funding. This could be achieved by three-to-four-year rolling budgets of formula-based block grants for core funding combined with competitive granting schemes and performance agreements backed with performance-based funding. The competitive granting scheme should incentivise institutional transformation and restructuring of the landscape, as noted above. In order to protect the resource base of the universities, part of the strategy should be to develop a robust vocational HE sector in the form of universities of applied sciences as well as distance education and blended learning models.

Part of this effort to introduce a real medium- to long-term research and innovation budget should go to the development of an explicit national strategy targeted at EU research and innovation to bring about a long-term shift in budgetary returns from the EU. The current high dependency on European Structural and Investment Funds (ESIF) weakens Poland's negotiating power in relation to the other EU-28, while a growing share of return from EU research programmes would strengthen the country's potential for economic and social prosperity.

Establishing a new joint funding formula for universities for both statutory education and research will be a welcome development but the government should continue to develop the formula. A limited number of transparent indicators and a clear link between indicators and strategic goals can help the government to steer the HE and science system in the desired direction. The formula should be built in a transparent and simple way to allow HEIs to immediately identify what change in behaviour will yield financial rewards. An objective way to distribute funds for recurrent expenditure is to use a formula linking the amount of resources spent on inputs to an indicator of institutional performance.

The current system of funding research based on the evaluation of research quality is not the best way to incentivise research performance. The panel proposes to abolish the link between research funding allocation and the SEDN system which currently forms the basis of the Comprehensive Evaluation of Scientific Units. It further recommends an evaluation of the costs and benefits of maintaining the National Science Evaluation System (SEDN) system. On the basis of this, the government should reconsider the value of SEDN as an instrument for government (and institutions) to monitor and inform policy development, which currently appear to be underdeveloped in the Polish HE and science system.

A significant part of R&D funding is allocated by means of competitive project-based funds through the National Science Centre (NCN) and the

National Centre for Research and Development (NCBiR). The government's decision to make increasing use of competitive funding is commendable, as it is an effective and flexible resource-allocation mechanism. To improve the competitive funding mechanisms, care should be taken to enhance transparency and international evaluation and ensure that the funding of overhead costs is sufficient.

It is equally important to ensure budget autonomy for at least the larger institutions, balanced with accountability. Budget autonomy is crucial for the efficiency of resource allocation and institutional development.

Leading research universities must find ways to better manage their resources to ensure the critical mass and focus of their research. The MNiSW could facilitate this by establishing **performance agreements with the key research-intensive universities to set quantitative or qualitative targets to be achieved in a given time linked to institutional funding**. The amount of funding at stake should be sufficient to act as an incentive, but not too high to impose a risk for the financial stability of individual institutions. The MNiSW could consider building transition or improvement periods into policy which give institutions that fail to meet targets additional time to enhance their performance. The focus should be on the scale of improvement, rather than absolute levels. Establishing an independent evaluation committee is important for the credibility of the assessment of the qualitative aspects of plans and their achievement.

There is significant scope for resource diversification from business collaboration, adult education and voluntary giving. When taking steps to encourage HEIs towards funding diversification, the government should recognise that the potential for resource mobilisation depends on the state of the surrounding economy as well as the institution's training and research capacity. To support university business and community engagement, the government could consider introducing a national competitive funding stream. Despite being a small component of HEIs' budgets, this type of an incentive could lead to substantial growth in industry/community engagement, as illustrated by the Higher Education and Innovation Fund for England (HEIF). Furthermore, investments in the fund-raising infrastructure and matched funding schemes for donations could facilitate the planned reform of the HE landscape, highlight the value of HE and research to society, reduce the dependency on public funding, and generate real rates of return for Polish HE, as has been the case in the United Kingdom and currently is in Finland where institutions invest donations and government-matched funding and use the profits for strategic openings during periods of financial stringency.

The planned HE system configuration, the worsening dependency ratios, and the eventual phasing out of the European funding via ESIF highlight the need for better cost-sharing in HE between the state and the students. Given the ambitions to develop a stronger hierarchy among HEIs, the government should avoid growing regressive elements in HE whereby students from advantaged backgrounds access high-prestige universities disproportionately at no private cost and obtain higher remuneration as graduates, but rely on less-advantaged taxpayers to fund their education. The introduction of tuition fees in full-time public education could be considered as part of a solution, but would require a change in the Constitution as well as a much stronger student-aid system to ensure that financial barriers do not constrain academically qualified students.

There is an immediate need to review the current student-support system to ensure adequate and sufficient student aid, including targeted needs-based grants, scholarships and student loans for students from disadvantaged backgrounds.

The key message for human capital and career structure development

> ***MESSAGE 4. Enhance the quality of the higher education and science and innovation system by radically reforming the doctoral training and academic career system.***
>
> *In order to generate state-of-the-art research competences, develop institutionalised (national) doctoral programmes or doctoral schools in line with international best practice. In addition, reform the academic career system to attract, nurture and retain talent, and to ensure that those in the HE and science system are encouraged to fully utilise their potential throughout their career.*

Current performance and results of doctoral training are suboptimal. A substantial proportion of the 40 000 doctoral candidates are inactive. The graduation age is high compared to the OECD average, and PhD holders are relative old and not flexible enough to permeate the market for advanced human capital. The existence of the habilitation degree lowers the level of PhD dissertations and PhD degrees and constitutes a loss to both taxpayers and institutions. It also leads to a too-high average recruitment age for full professors (over 50 years), which is significantly higher than in most competitive HE systems.

Poland should support the stimulation and training of best talents using international best practice from advanced economies by incentivising the development of institutionalised (national) doctoral programmes or doctoral schools. This would imply tightening up the entry to doctoral programmes, consolidating their duration, developing structured programmes that address both disciplinary and interdisciplinary knowledge as well as transversal skills, and focusing on the wider labour market. Doctoral training could be concentrated at the strongest universities, which would accept and be held accountable to nationwide responsibilities (e.g. PhD training in key priority areas) and admit talented students from all over Poland, as well as other countries, with a minimum of 25% target for foreigners. International experience, from Denmark for example, shows that the successful modernisation and expansion of doctoral training can change career pathways into research, academia, postdoc programmes, etc.

The current Polish HE and science career system does not appear to take full advantage of careful recruitment standards or offer sufficient research opportunities to young talents. The system is hampered by many factors such as the barriers which delay the opportunities to conduct independent research (including habilitation), academic inbreeding, low levels of internationalisation and mobility, a lack of systematic continued professional development and flexibility in rewarding talent, and a gender bias. Many Polish academic staff and researchers are rarely benchmarked and assessed against a transparent set of quality criteria. In the current system, although employees of HEIs and public research organisation (PROs) must undergo regular performance evaluations, which include criteria related to scientific achievements, these evaluations seem to remain a formality in most public institutions. Individuals with a track record of years of underperformance may continue to receive research resources, which is a drain on resources and demotivates productive staff. **In order to advance as a knowledge society, Poland must develop academic staff and use scientific quality criteria, as well as pursue a broad labour market focus.**

Public universities could develop an incentive system based on individualised plans negotiated between staff and deans. If agreed targets are achieved, additional internal funding or improved resources can be provided, permitting greater flexibility. Universities could also make more flexible use of workloads, allocation of time and resources for research that are agreed upon between staff and managers, including performance targets, backed up with appropriate annual appraisal and rewards. Other incentives include supportive conditions for teaching, opportunities for individual development through mobility, academic freedom and additional responsibilities.

One key step is to have a better-functioning tenure-track career system, which is characterised by three key elements: (i) an entry position, which new talented individuals can apply for in order to access a career as a researcher and/or teacher; (ii) career pathways; and (iii) sticks and carrots to enhance and ensure quality performance. Such a system functions in a supportive way so that the staff can develop and their potential is fully utilised.

Poland must respond to the existing discrimination towards female researchers. Despite commendable progress made in increasing women's participation in HE and the science system, there is a clear gender bias in academic titles and positions as well as in the distribution of research grants. The gap between men and women widens with rank. Female doctoral candidates and female scholars remain in a disadvantaged position in recruitment to academic positions, access to research funding, and promotion to higher academic positions. Since the employment legislation for academic staff also grants more job security to senior categories, Polish female researchers are not only under-represented in prestigious and influential positions, but are also more exposed to precarious employment conditions.

The key message for quality assurance and evaluation

MESSAGE 5. Enhance the adoption of sound evaluation practices and a quality culture to support the diversified higher education and science system. This should be based on a lean, effective and transparent system of quality assurance and evaluation for higher education and science built on the following principles: (i) simplify the quality assurance system architecture; (ii) align the system with international standards to enhance excellence and reduce state control; and (iii) improve transparency and openness.

Regular external evaluation of publicly funded programmes and institutions – with international participation – should cover all parts of the HE and science and innovation system. Evaluation should be firmly embedded in the policy cycle so that results would feed back into subsequent rounds of support and policy design.

Quality involves setting ambitious goals and working effectively to achieve them. In a diverse HE system, aspirations, challenges and solutions vary from one institution and academic environment to another, reflecting diversity among educational and research traditions. **The planned diverse HE system should be supported by mission-differentiated institutional evaluation and accreditation criteria.**

On the road towards excellent science, a key element is the **reorientation of research evaluation from an overly bureaucratic exercise into an instrument that enhances research impact**, rather than the current system which is output-oriented and used for funding allocation purposes. Currently, the Comprehensive Evaluation of Scientific Units categorises units according to their quality (A+, A, B, C). It is mainly based on a count of publications and awarded titles, and has significant implications for funding. The MNiSW plans to scale down the amount of regulation, reducing the number of grading criteria from four to three and moving the focus from scientific units to field specific evaluations, and to introduce a new B+ grade.

In the view of the review team, **the research evaluation system should be geared towards a system that facilitates and incentivises continuous improvements in high-quality research performance. This would imply three pillars: (i) an assessment of research performance; (ii) a careful evaluation of the impact of research, taking into consideration the field-specific needs; and (iii) regular international peer reviews, covering all fields and institutions.** The identification of potential flagships should be facilitated by a combination of competition and selection by an international review. The linkages between the funding allocation and the data system (SEDN) behind the Comprehensive Evaluation of Scientific Units should be abolished. If the benefits of maintaining the SEDN system exceed the costs, with some adjustments and better links to scientific impact, SEDN could provide sophisticated monitoring of an exceptionally diverse set of 'scientific events' and a valuable policy instrument for monitoring and informing policy development, which currently seem to be underdeveloped in the Polish HE and science system.

Educational quality must be the responsibility of the academic environment as a whole, including HE leadership, staff and students. HEIs should provide an education that not only meets the prescribed requirements and demands for quality, but continually seeks to evolve and improve. This can be achieved **by moving away from the current system of state control towards incentivising a quality culture of and within institutions.** Currently, study programme evaluations are perceived as an obligation or punishment rather than support for improvement in performance and quality. A useful step would be to **refocus the work of the Polish Accreditation Committee (PKA) on assessing the quality of institutional quality-assurance systems**, aligned with the diversified HE system. The PKA could also be charged with evaluation of the quality of doctoral programmes as part of the institutional quality-assurance system. While every institution cannot be equally good at everything, all institutions can be very good at some things and sufficiently good at the rest. This implies that institutions should avoid those academic fields where they fail to perform at an adequate standard.

At the individual level, the current evaluation systems focus on successive points of control of perceived quality in terms of diplomas and promotion, which has led to an overly conservative system which restricts innovation. HEIs should develop systems for recognising good teachers and promoting their academic careers and raising the status of teaching.

With respect to awarding the title of professor, the international standard now is to transfer this right to the HEI concerned. This would also facilitate capacity building and institutional profiling.

THE KEY MESSAGE FOR THE THIRD MISSION AND SYSTEM LINKAGES (Chapter 5)

> ***MESSAGE 6. Ensure a broad approach to innovation through universities' third mission and system linkages, by stimulating academic and student entrepreneurship and third-mission activities based on cooperation between universities and industry, as well as with the public sector and civil society.***
>
> *HE and academic research are vital for competitive innovation capabilities but investments in the science base alone is not enough to guarantee innovations or societal and economic returns. In order to improve the national innovation performance and the relevance of university research and education, greater efforts should be made in knowledge exchange based on an interactive and long-term relationship between universities, industry and the wider community. Invest in developing university-industry learning environments which: (i) support the skills and human capital development required to adopt and apply process and product innovations, (ii) work with SMEs as well as large corporations and (iii) measure success in terms of the sustainability and transformation of industry and employment growth.*

HEIs' third mission and engagement with society and industry remain a challenge in Poland despite successive efforts by the government. Action is limited to a narrow range of activities, with emphasis on research publications, graduating students and mostly linear models of knowledge transfer. Collaborative R&D is small in volume and the quantifiable outcomes of science and industry cooperation modest. Universities and most research institutes earn small revenues from knowledge transfer. University incubation activities are embryonic and spin-offs from university research limited. Technology Transfer Centres (TTCs) lack relevance across the system.

The related policies in HE and R&I in Poland primarily focus on technology transfer, copying the US-type commercialisation efforts, which are unlikely to yield expected results, while disregarding a broader knowledge exchange and the role of HEIs in addressing societal challenges. Past funding streams have framed the third mission in narrow terms as a tool for diversification of HE funding rather than long-term industry and community engagement embedded in, and delivered through, teaching and research. Institutions' administrative procedures and governance processes remain a barrier to industry cooperation and community engagement.

The new reform plans would benefit from a clear focus on the third mission and the HE and system linkages which are key to the competitiveness of the innovation system and research and education excellence, as well as focusing on the crucial role of students in knowledge transfer and community engagement. Given the low absorptive capacity of the economy, Poland needs not only a highly skilled population that can adjust to the changes in the labour market, but also a knowledge-based economy and new businesses that can absorb these skills.

The current instruments fostering science-industry collaboration should be evaluated in view of developing a more robust policy focus on collaborative university-industry partnerships while drawing lessons from international experience in the instrument design, e.g. Sweden's Competence Centres. Technology Transfer Alliances at the regional level could overcome the difficulty to generate sufficient deal flow and income to cover the expenses of the TTCs. **An elaborate analysis of business sector RDI and the industry-academia interaction could inform the reform process**.

International evidence points to the need for governments and HEIs to adopt a broad approach to knowledge exchange. While patents, licences and spin-offs remain important channels for commercialising public research, **other channels, such as student entrepreneurship, collaborative research, student and faculty mobility across all fields, and faculty consulting, are likely to help generate better results and change the underlying culture**. Long-term industry collaboration can also help determine which research and inventions have potential as the basis of innovation and economic returns.

Poland's approach to the ownership of Intellectual Property Rights (IPR) from government-funded research has changed twice in a few years, which may have contributed to a lack of competence and knowledge about IPR. Currently, a mix of institutional and inventor ownership is implemented. Whatever IPR model is used, incentives should

ensure that academics report their IP holdings to their universities. These incentives should cover not only technology disclosure but also knowledge disclosure, e.g. data sharing.

To tackle the low performance of public research institutes, the government is establishing a network organisation Research Network Lukasiewicz (in place of the originally planned National Institute for Technology, NIT) which will bring together some of the 114 existing research institutes. The reform aims to create synergies, avoid duplication of efforts and ensure efficient management. Care should be taken to ensure that the cost of the consolidation does not surpass its benefits and that the best-performing institutes do not risk losing their market position, clients and certifications. As noted above, **the panel favours a solution whereby the best-performing research institutes are incorporated into universities. In any case, doctoral-degree-awarding powers should always be invested with the universities.**

For most HEIs, the city and its surrounding environment provides the natural framework for industry collaboration and community engagement. Regional engagement can take many different forms depending on the capacity of institutions and the region's needs and assets. **Currently, the local and regional engagement of HEIs – including industry collaboration, skills development, community engagement and entrepreneurship activities – is weakly reflected in the HE policy and institutional set-up**. Public higher vocational schools should play a strong role in local development but they suffer from declining student enrolments and the lack of work-based learning opportunities. Poland's plans to reform vocational HE could be more ambitious and aim at developing a university of applied sciences sector, possibly influenced by the highly successful 'dual university' model. **The reformed university and vocational HE sectors should also better address adult education and reskilling and upskilling needs, which are currently being neglected.**

The government could also consider a strengthened role for regional authorities in the regulation and financial instruments involved in co-establishing the HE offer. This could be accompanied by the transfer of European funds related to HE from the national to regional level to facilitate long-term policy planning, instead of ad-hoc actions based on annual budgeting. In any case, consulting with regional governments on HE reforms and changes and national funding for HEIs consolidations will be necessary.

Universities should be encouraged to go beyond their traditional role of knowledge producers and embrace a more robust conception of innovation. The risk aversion among domestic firms and HEIs combined with the availability of significant amounts of EU funding has contributed to a large public role in the innovation system which may have led to the funding of initiatives and innovations which are not commercially viable without subsidies. Strong government presence and publicly-driven innovation system may be undercutting its own goals of developing entrepreneurship. **The risk is that the ability to attract public funding for an idea becomes the measure of success, rather than its success in the market**. It is important that the government fosters a sense of responsibility to show an overall positive return on public investment, the bulk of which comes from the EU.

THE KEY MESSAGE FOR INTERNATIONALISATION (Chapter 6)

MESSAGE 7. Develop a broad-based internationalisation strategy for Poland that sets out clear orientations and actions to promote the internationalisation of Polish science and innovation, mainstreaming internationalisation in existing policies, programmes and institutions.

This strategy should facilitate the circulation of foreign and national students (as well as 'internationalisation at home' to ensure that non-mobile students and staff will also benefit), secure adequate public investment to support the internationalisation of R&I activities, and encourage public R&I institutions to put in place the necessary support mechanisms to increase their participation in international networks, including through better science-business links.

Poland needs strong efforts to be an active partner in the global brain-circulation system. With only 0.4 % of global research and 64 % of active researchers who have only published with an affiliation within Poland, the country risks being left on the periphery of the global knowledge-exchange structure if it does not prioritise participation in international networks (see Kamalski and Plume 2013). Openness of the research system is positively correlated with high scientific quality since scientists achieve greater impact when they collaborate internationally. **A broad-based internationalisation strategy could set out orientations and actions to promote internationalisation, which should be mainstreamed in existing policies and programmes. Such a strategy should provide strategic orientation while respecting bottom-up activities in the HE, science and innovation system.**

Steps to enhance the internationalisation of existing staff in the HE and science system could include using international linkages as decisive criteria in assessing proposals for supporting research centres – ensuring that international experience is a merit in academic career progress – or further incentives for young researchers to go abroad for at least part of their PhD or postdoc training. Institutions should also develop programmes to support international engagement across different fields, to address any imbalances.

There is considerable short-term potential to continue to expand faculty and student exchanges, which currently benefits only a minority of the HE community, in order to bring more diversity into Polish classrooms while granting faculty and students reciprocal opportunities to visit institutions abroad. Promoting greater participation in international exchanges and developing robust policies to support internationalisation at home should be a priority for the HE system, with support from the government potentially in the form of faculty grants, student bursaries or financial incentives for institutions.

Developing a strong research community is one of the most challenging elements in building a world-class HE and science system. This could be achieved by bringing top foreign academics and researchers to Poland to pursue leading-edge collaborative research across national borders. **Attracting long-term faculty and doctoral candidates from outside Poland is clearly a long-term challenge, connected with ongoing improvement in the quality of the HE and science system, more attractive career paths for early-stage researchers and economic development in Poland.** Investing in the science base could be part of the solution, but will not necessarily improve the international attractiveness if other barriers remain. This would require policies to internationalise Poland's labour market and education system and address discrimination and xenophobia. There is also a need to ensure that the institutions continue to seek the right balance between global reach and local engagement, forming strong links with local economic actors.

1 INTRODUCTION, AIM AND METHODOLOGY

1.1 Policy Support Facility

The Policy Support Facility (PSF) is a tool set up by the European Commission – DG Research and Innovation under Horizon 2020, the EU funding programme for R&I, to support Member States and countries associated to Horizon 2020 in improving the design, implementation and evaluation of national R&I policies.

The Horizon 2020 PSF peer reviews of national R&I systems comprise one of the main services offered by the PSF. Peer reviews constitute an in-depth assessment of a country's R&I system carried out by a panel of international experts and peers at the country's request. The panel formulates concrete and operational recommendations for the national authorities on reforms which are necessary to improve and strengthen the quality of the national R&I system.

1.2 Context

In February 2016, the Polish government adopted the **Responsible Development Plan** (the so-called 'Morawiecki Plan'), a long-term economic development plan which identifies five major growth barriers for the Polish economy: (i) middle-income trap; (ii) excessive reliance on external financing; (iii) low innovative capacity of the economy; (iv) demography; and (v) weak institutions.

The plan is elaborated in a more comprehensive **Strategy for Responsible Development**[1] (*pl. Strategia na rzecz Odpowiedzialnego Rozwoju*) adopted in February 2017. This strategy identifies the economy's limited capacity to innovate as one of major growth barriers in Poland. It includes a number of measures to overcome barriers to innovation and to make it easier to do business, as well as a stronger thematic focus of R&D investment by prioritising national and regional smart specialisations. The new strategy's specific R&D development goals include: (i) 1.7 % GDP for science and research until 2020; (ii) more Polish innovative products and services which are competitive on global market; (iii) support for high-tech start-ups; (iv) targeted support for selected sectors with high competition potential (i.e. cybersecurity, electromobility, biotechnology); and (v) HE and research entities as a source of human capital and innovative R&D results.

Since the country's development, based on knowledge and the increasing competence of society, has no chance of success without effective science and HE sectors, the Strategy for Responsible Development puts a strong focus on the need to develop the HE and science sector in line with the three pillars of the **Strategy for Higher Education and Science** (i.e. Strategy for excellence in science, modern higher education, business partnership, and social responsibility of science) announced in September 2016 by the deputy prime minister and minister for science and higher education, Jaroslaw Gowin.

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[1] https://www.mr.gov.pl/media/34300/SOR_2017_maly_internet_14072017_wstepPMM.pdf

The so-called Gowin's Strategy for Science and Higher Education consists of three pillars: **Constitution for Science** (changes in the HE system by the forthcoming Law 2.0), **Innovations for the economy,** and **Science for You** (societal impact of research; National Congress of Science).

The first pillar of the Gowin's Strategy - Constitution for Science - proposes **a comprehensive reform of the HE and science system (the so-called 'Law 2.0')** aimed at making the HE system more efficient, closer to the needs of society and the economy, and unlocking the research potential of the Polish universities. According to the **initial vision of Law 2.0**[2], presented to the PSF panel by the Polish authorities, this law will introduce a new approach to managing the HE sector by making it more autonomous and less bureaucratic, able to promote scientific excellence, open for interdisciplinary research, and open to the world. Measures announced include the introduction of new formulae for financing HEIs and PROs; a new evaluation system for HEI and PRO's activities; introduction of three types of HEIs – research universities, research and teaching universities and teaching universities - and industrial ("implementation") doctorates[3].

The MNiSW has launched wide-ranging consultations on the planned reforms with academics and researchers, i.e. through the **National Science Congress**[4] - a series of meetings with the scientific community organised in several Polish cities during 2016-2017 to discuss key challenges in the Polish science and HE system and possible solutions.

In addition, three teams of Polish researchers, selected in the open competition, received grants to prepare their vision on the assumptions of the new Law 2.0. The first team was led by Prof. Marek Kwiek (from the Adam Mickiewicz University in Poznań). The second team was supervised by Prof. Hubert Izdebski (from the University of Social Sciences and Humanities). The third team was led by Dr Arkadiusz Radwan (from the Allerhand Institute). As a result, three competing concepts[5] of specific objectives of Law 2.0 were presented in January 2017.

To complement this internal discussion on the new reform via an external perspective, the MNiSW decided to request the **independent advice of high-level international experts and peers through the Horizon 2020 PSF.**

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2 See: https://rio.jrc.ec.europa.eu/en/policy-support-facility/peer-review-polish-research-and-innovation-system

3 Law on implementation doctorates adopted on 27 April 2017: http://orka.sejm.gov.pl/opinie8.nsf/nazwa/1287_u/$file/1287_u.pdf

4 See: https://nkn.gov.pl/

5 See: http://www.nauka.gov.pl/aktualnosci-ministerstwo/ustawa-2-0-prezentujemy-pomysly-zwyciezcow.html

1.3 Aim and focus areas of the Horizon 2020 Policy Support Facility Peer Review

In his letter of 6 September 2016, Poland's deputy prime minister and minister of science and higher education, Jaroslaw Gowin, expressed the country's interest in the support of the Horizon 2020 PSF for an independent peer review of the Polish science and HE system, outlining key areas in need of in-depth evaluation and recommendations for further structural changes. In compliance with this request, the peer review aims to provide external advice and recommendations for restructuring the Polish science and HE system in support of innovation, in particular, or new laws on science and HE to be prepared by 2019.

The specific focus areas of the peer review were:

- **Structural changes in the science and HE system, including:**
  - Models of output evaluation (public and private sectors);
  - Consolidation vs. restructuring/ streamlining of HEIs; incentives or legislation;
  - Career development of researchers (research and teaching);
  - Research universities vs. higher vocational education;
  - Role of regional authorities in shaping the HE system in the region.
- **Links between the HE sector and other actors of the innovation system:**
  - Financing pro-innovation activities in the HE sector (grants vs. institutional funding); methodology for financing specific types of institutions, including ways of contracting tasks in scientific institutions and universities;
  - Commercialisation of research results.
- **Internationalisation of the science and HE sector - trends, key areas for improvement.**

Thus, the **Horizon 2020 PSF peer review will be part of an exercise collecting evidence for Law 2.0**: key policy messages and recommendations reflect the specific focus areas proposed by the Polish authorities and are backed by evidence, best practice, and analyses of similar approaches and reforms introduced in other countries.

The three focus areas are reflected in the structure of this report:

- Chapter 2 sets the scene by outlining Poland's socio-economic situation and offering basic information on the HE and science system and linkages, as well as human resources;

- Chapter 3 addresses the first set of questions on system reform of the HE and science landscape as well as linkages between HEIs, research institutes and the Polish Academy of Sciences;

- Chapter 4 focuses in more detail on questions on the key framework conditions and government steering instruments: governance, funding, HR policies, as well as quality assurance and evaluation;

- Chapter 5 addresses the second set of questions on links between the HE sector and other innovation system actors, mainly industry, as well as third-mission and regional development activities;

- Chapter 6 responds to the third set of questions addressing the internationalisation of the HE and science system.

These chapters present a situational analysis, identify barriers and bottlenecks, and make policy recommendations, supported by relevant examples of good practices from other countries.

Thus, the key focus of the report is the HE and science system reform. It does not provide a full analysis of the teaching and learning aspects of the Polish HE system or the students' situation. Any HE system reform must acknowledge and protect students' interests. Furthermore, it must be acknowledged that the most important role any higher education institution can play is educating the young minds who will change the world of work and society.

1.4 Methodology

The Horizon 2020 Policy Support Facility peer review was undertaken by a panel of independent experts from Austria, Denmark, Finland, Sweden and the Netherlands, acting in their personal capacity, as well as three peer reviewers as policymakers from Austria, Belgium and Sweden.

The PSF peer review of Poland's HE and science system started by gathering and analysing qualitative and quantitative information from Polish and international sources and mobilising the key actors in Poland's HE and science system. The self-assessment report (in PowerPoint), drafted by the MNiSW, and the PSF background report on Poland's science and innovation system were an important starting point for the PSF panel's work. In addition, relevant stakeholders and legal documents were translated into English for the panel, including the three competing proposals for Law 2.0 (Radwan et al., Kwiek and al., Izdebski et al.).

The references section lists the documents cited in the report or analysed during the procedure.

The PSF panel made two visits to Warsaw. A fact-finding visit from 6-10 March 2017 included meetings with stakeholders, i.e. the MNiSW, other public administration bodies, HE and science performers, intermediary organisations in the HE and science system, and individuals and bodies representing HE and science actors and interest groups. The panel discussed its preliminary findings with an extensive set of Polish stakeholders during the second country visit in June 2017. Numerous organisations and individuals provided their written input for the panel. The work was based on information collected until the end of June 2017. Subsequent evolutions were not taken into account.

The PSF panel drafted this independent report on the basis of the documents analysed, the panel's assessment of stakeholders' proposals for changes in the science and HE sector, Poland's feedback on the panel's preliminary findings, as well as by drawing on discussions with stakeholders and experts and comments received during the field visits.

1.5 Follow-up to the Horizon 2020 Policy Support Facility Peer Review

The panel recommends an adequate follow-up to this peer review within one to one and a half years from the report's release to look at any developments made since then. In line with the PSF principles, it is the country's responsibility to ensure this follow-up and implementation of the recommendations through concrete reforms.

A presentation and discussion of the Horizon 2020 PSF peer review with the national parliament would be an asset. The Horizon 2020 PSF envisages the possibility of a "post peer review" exercise that would allow the peer-reviewed country to request the peers and/or experts to provide comments on implementation of the recommendations. Moreover, the national authorities can continue to call upon the PSF for tailored support on how to tackle a specific R&I policy challenge or implement an accompanying reform.

Finally, the panel also proposes a follow-up review of the broader innovation landscape, including instruments and mechanisms contributing to the science-industry links (see chapter 5.5).

2 CONTEXT

2.1 Introduction

Poland's HE and science system is facing a number of challenges and opportunities in terms of performance, governance and impact. This chapter aims to contextualise the subsequent analytical chapters of the report. It provides an overview of the economic situation in Poland and highlights what the panel sees as the main strengths and weaknesses in the key areas of the HE, science and innovation system. Data in this chapter in mainly based on an analysis of Poland's HE and science system and its challenges in the 'Background Expert Report on R&I Policies 2016: Poland' (Klincewicz and Marczewska, 2017) by the European Commission's Joint Research Centre.

2.2 The socio-economic situation

Poland benefits from long uninterrupted economic growth, including a steady rise in GDP per capita. Since 1989, Poland's GDP per capita has more than doubled, at a higher growth rate than any other EU country. Unlike the other EU countries, Poland weathered the post-2007 global financial and economic crises without going into recession. In 2015, Poland's GDP per capita expressed in purchasing power standards reached 69 % of the EU average, up from 53 % in 2007. Driven by domestic private consumption, real GDP is expected to grow at robust rates between 3.1 % and 3.2 % per year in 2017 and 2018, well above the EU average (EC 2017a),

Long-term economic growth is challenged by an ageing population and slowing productivity growth. Compared with the other EU-28 countries, Poland's labour productivity is low, although growing, thanks to transition and integration processes. The labour productivity per person increased from 61.2 % of the EU average in 2008 to 74.3 % in 2015, although efficiency gains are becoming harder to achieve as Poland catches up with more advanced EU countries. Long-term economic prospects will depend on the country's ability to move from producing low-technology goods to more advanced products and services. This will require inclusive education that gives people adequate skills and competences, and improving the quality of HE and applied scientific research (EC 2017a).

Rising incomes and living standards have been accompanied by increases in employment, reducing unemployment to a record low (EC 2017A). In 2016, employment rose by an estimated 0.9 %, for the third year in a row. Following a robust and steady improvement over the last decade, the employment rate reached a record high of 69.7 % in Q3-2016 (for the 20-64 age group), but remained below the EU average of 71.5 % due to the lower participation of older workers, women and low-skilled people. The gap is expected to grow because new labour market disincentives are targeting these groups. The unemployment rate continued to decline in 2016 and 2017, reaching a record low of 5.3 % (EU-28: 8 %) in the first quarter of 2017, down from 9.7 % in 2010. With unemployment at a record low, lifelong learning is becoming even more crucial.

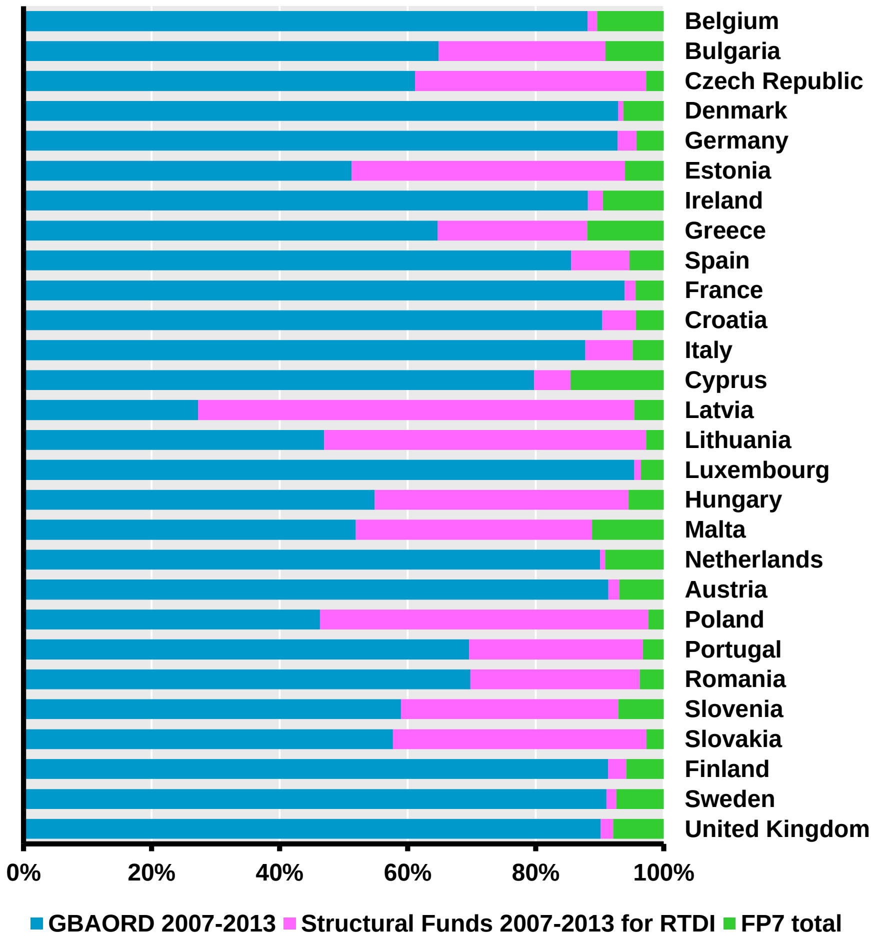
Poland's performance in basic education remains strong with a low early-school-leaving rate, but adult skills are at a low level. Poland is among the best EU performers when it comes to reducing the number of early school leavers, at 5.3 % in 2015, compared to the EU average of 11 % (EC 2016a). Performance in basic skills is better than both the EU and OECD average, although Poland's scores in the Programme for International Student Assessment (PISA) have declined (OECD 2016a). Basic skills levels for adults are comparatively poor, particularly in ICT (EC 2016b). The OECD Survey of Adult Skills (PIAAC) scores testing the numeracy of Polish adults were lower than the OECD average (OECD 2016a). Employers' surveys indicate increasing difficulties in filling vacancies (e.g. Manpower 2016). Migration affects skill distribution in the labour force, as Polish emigrants tend to be better educated than the rest of the population. At the same time, many immigrants in Poland work below their qualification level (EC 2017a).

An increasing share of Poland's population requires education and (re)training to be able to meet the changing skills needs, but lifelong learning and education pathways remain underdeveloped. Given the declining youth cohorts and low adult skills, Poland must ensure that older generations have up-to-date skills. Currently, the country has the lowest participation rate in adult education among all EU countries at all levels of education.

HE performance in Poland is mixed. The Education and Training Monitor (EC 2016a) shows that the tertiary education attainment rate for 30-34 year olds has quadrupled in the last 15 years to 43.4 % in 2015, above the EU average of 38.7 %. The employment of recent HE graduates was high at 85.1 %, which is also above the EU average (81.9 %). At the same time, the quality of HE and its labour market relevance remain challenging (EC 2016a). An increasing number of highly educated people are in medium- or low-skilled jobs which points to skills mismatches (Commission 2015). Adult participation in lifelong learning is one of the lowest in the EU (8.1 % in higher education vs. 18.8 % EU average). The level of tertiary attainment among 55-64-year-olds is one of the lowest among OECD and partner countries (13.6 %, ranked 35/44) (OECD Education GPS).

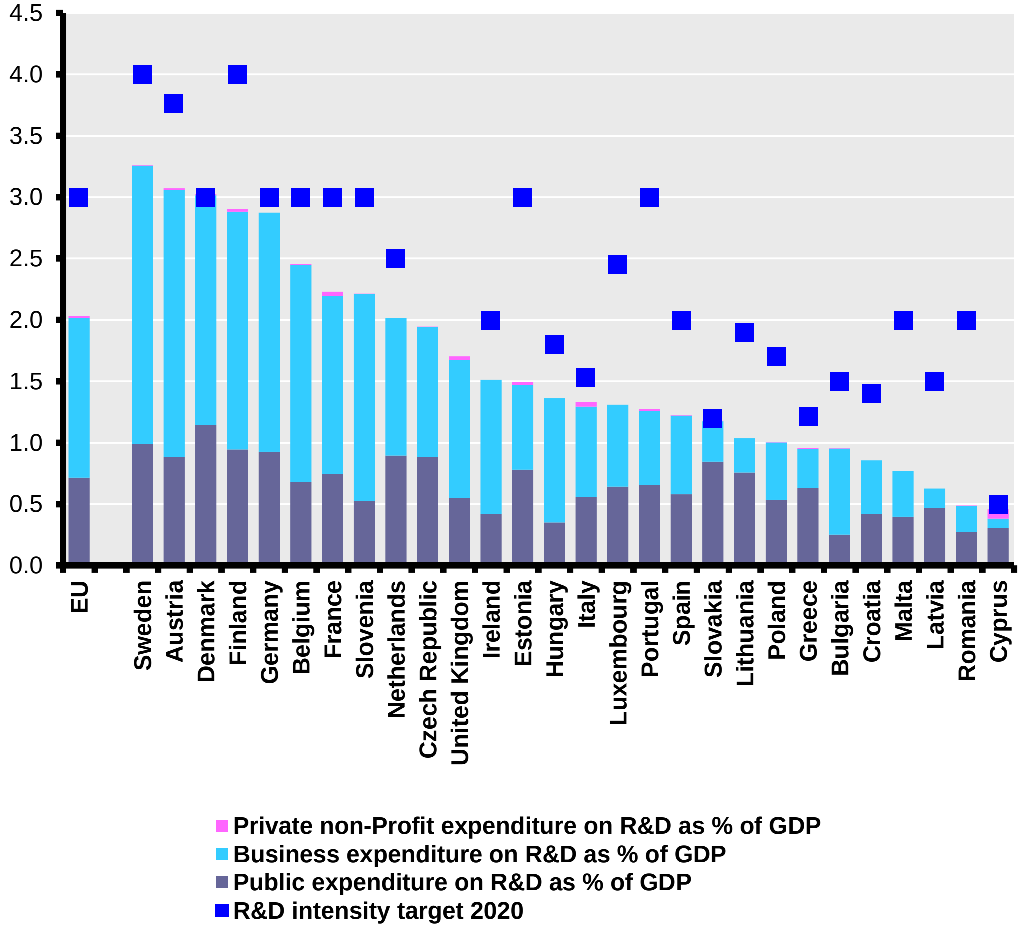
R&I are increasingly seen as engines of long-term growth, but HE and R&D spending and R&D intensity are low. R&D investment in Poland relies predominantly on public financing, with important support provided by the European Structural and Investment Funds (ESIF) (EU, 2016b) (see Figure 1). Gross domestic expenditure on R&D (GERD) amounted to EUR 4.31 billion in 2015 and increased by 11.7 % and 54.5 % respectively compared to 2014 and 2011 (Gulda et al. 2017). R&D intensity rose from 0.6 % of GDP in 2007 to 1% of GDP in 2015, half the EU average of 2 % and one of the lowest in Europe (see Figure 2). The government is committed to reaching the EU2020 national R&D intensity target by 2020 (1.7 % of GDP). Business enterprise expenditure on R&D (BERD) is growing from a low base (0.44 % of GDP in 2016), but remains one of the lowest in the EU. (EC 2017b)

Figure 1: Shares of GBAORD, Structural Funds allocated to RTDI and FP7 funds, 2007-2013 (%)



GBAORD = Government Budget Appropriations or Outlays on Research and Development
Source: European Commission 2016 'Science, research and innovation performance of the EU 2016. A contribution to the Open Innovation, Open Science, Open to the World agenda', page 149, Figure 11-2-8

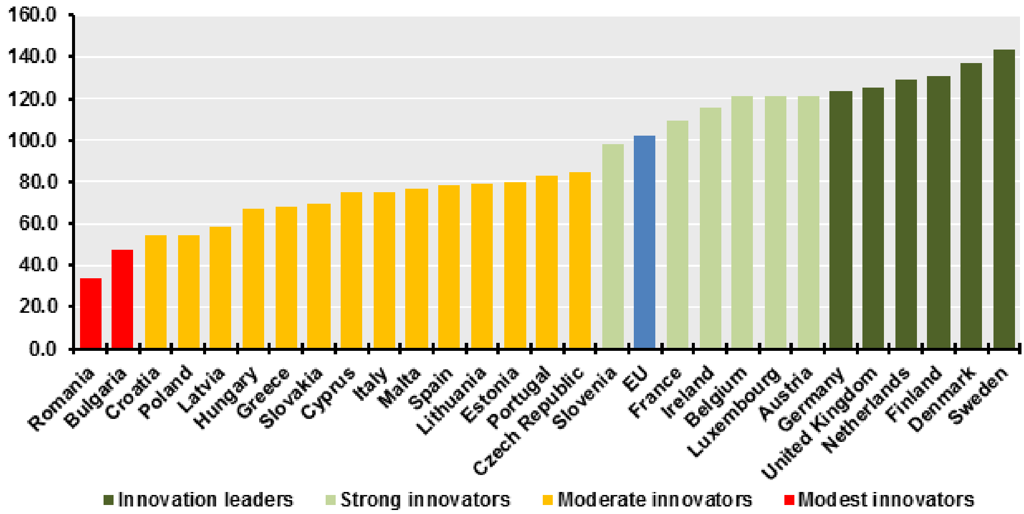
Figure 2: R&D intensities broken down by sectors, 2015(1) and R&D intensity targets 2020



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: Eurostat
Notes: (1) IE: 2014; CZ, UK: R&D intensity targets are not available. (2) IE: The R&D intensity target is 2.5 % of GNP which is estimated as equivalent to 2.0 % of GDP. (3) LU: The R&D intensity target is between 2.30 % and 2.60 % (2.45 % was assumed). (4) Notes: (1) IE: 2014; CZ, UK: R&D intensity targets are not available. (2) IE: The R&D intensity target is 2.5 % of GNP which is estimated as equivalent to 2.0 % of GDP. (3) LU: The R&D intensity target is between 2.30 % and 2.60 % (2.45 % was assumed). (4) PT: The R&D intensity target is between 2.70 % and 3.30 % (3.00 % was assumed).

Poland's R&I performance has improved marginally over the last decade, but the quality of science and innovation outputs are below EU standards (Figure 3). According to the European Innovation Scoreboard, Poland is a moderate innovator: over time, its performance has increased by 2 % relative to that of the EU in 2010, but relative weaknesses remain, linked to innovators, linkages and entrepreneurship and attractive research systems. For most indicators, performance is also below the EU average, with the largest relative weaknesses in non-EU doctorate students, public-private co-publications, PCT patent applications (in societal challenges) and innovative SMEs. According to the 2017 results, Poland's ranking has declined further, despite some improvements in performance, while countries such as Lithuania and Latvia have made greater progress. Notably, since 2010, the number of new PhD graduates fell by 13.2 % and foreign doctorate students by 2 %; numbers of innovators and the science-industry have also declined (EC 2017b).

Figure 3: EU Member States' innovation performance



Source: European Commission, DG Research and Innovation and DG Internal Market, Industry, Entrepreneurship and SMEs
Data: European Innovation Scoreboard (EIS), 2017
Note: The values show Member States' performance in 2016 relative to that of the EU in 2010. Member States' performance groups are based on their relative performance to the EU in 2016
http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

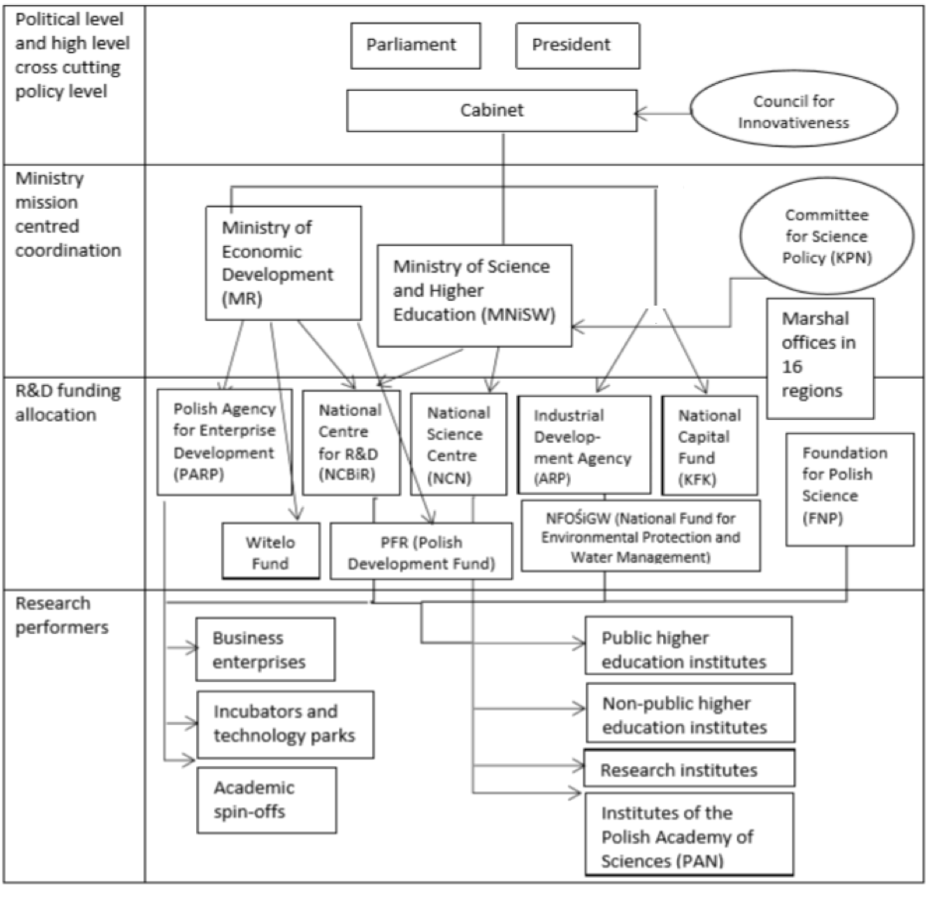
2.3 Governance of the research and innovation system

Poland's R&I system is centralised, with the national government defining policy directions and allocating funding through its agencies. Figure 4 presents the key R&I policymakers, funders and performers in Poland.

In January 2016, the current government reinforced the overall governance framework for R&I systems by creating an Innovation Council to coordinate innovation policies. Chaired by the deputy prime minister (who is also minister for economy, development and finances), it comprises ministers responsible for the key sectors for implementing innovation policies (including the minister of science and higher education, minister of digitalisation, and the minister of culture). The council sets the main directions for economic development and innovativeness of the economy, but does not oversee the coherence of the HE and science system.

Multiple dedicated government agencies (Figure 4) face the challenge of creating operational synergies to integrate HE and R&I policies. Two ministries set the directions and deliver the policies related to innovation. The ministry of economic development (MR) focuses on economic development and innovativeness of the economy, while the MNiSW focuses on policies linked to the organisation of science and HE, managing the science budget, and supporting the development of Polish universities, research institutes and research institutes of the Polish Academy of Sciences. The MNiSW oversees the funding agencies that allocate funding for basic science (NCN) and applied research and innovative development, including business enterprises' R&D projects (NCBiR). Both ministries also have their own support schemes.

Figure 4: Governance structure of the Polish R&I system



Source: Klincewicz & Marczewska (2017), Background Expert Report on R&I Policies 2016: Poland 2017, Joint Research Centre

Note: Since the first publication of this figure, the institutional R&I system has changed, e.g. PFR has other linkages with PARK and KFK which is part of BGK, not mentioned in the current figure). The Vitelo Fund has been established and is supervised by NCBiR; the PFR coordinates activities of PARP, KFK and ARP.

A dense network of councils, committees and advisory and representative bodies support the HE and science system[6]. Some of the bodies appear to have partly overlapping mandates, unclear reporting responsibilities, differing levels of autonomy and vested interests. R&I funding is distributed by numerous agencies. Apart from the MNiSW, with specified competences in this domain, there is a lack of functioning oversight of the coherence of Poland's HE and science policy.

The government has also declared plans to rationalise the funding landscape. Better coordination of funding instruments is one of the main goals of the Polish Development Fund, which coordinates the funding activities of PARP, BGK, KFK and ARP.

The new Innovation Council set up by the prime minister may have the potential to support the policy coordination required, but the council lacks stakeholder participation, and its remit, powers and budget are unclear[7]. Currently, an effective mechanism for coordinating activities across the HE and R&I appears to be lacking. There is no scheme to ensure adequate oversight of the interconnecting domains of a fully functioning innovation system, which demands coherence between policies affecting education, research, innovation and market development. For example, ERAC mutual learning findings show that engaging a wide range of stakeholders in the early stages of policy development enables a clear identification and articulation of problems for which suitable innovation policy can be created (a worthwhile example for Poland is the UK Council, see Edqvist 2014). The Innovation Council could provide a strong basis for the R&I system by forming an arena where key actors from government, agencies, academia, industry and society together develop a policy consensus that has the government's authority based on system-wide overview. This will depend on whether the Innovation Council will reach across multiple ministries and agencies as well as other sectors of society and stakeholder groups, including academia, industry and society.

Currently, no single organisation appears to be in charge of monitoring the innovation system, producing indicator reports and contributing to the evaluation of (or part of) the system. This is important in the light of the numerous strategies developed in recent years (Strategy for Responsible Development, the national research programme, etc.), each with different goals, targets and objectives that should be monitored.

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[6] Committee for Science Policy (KPN), Central Council of Science and Higher Education (RGNiSW), Committee for Evaluation of Scientific Units (KEJN), The Polish Accreditation Committee (PKA), Central Commission for Degrees and Titles, Conference of Rectors of Academic Schools in Poland (KRASP), Conference of Rectors of Polish Universities (KRUP), Conference of Rectors of Polish Technological Universities (KRPUT), Conference of Rectors of Public Schools of Higher Vocational Education (KRePSZ), The Main Council of Research Institutes (RGIB), National Representation of Doctoral Students (KRD), Graduates Affairs Ombudsman, The Citizens of Academia (Obywatele Nauki)

[7] Here we mean stakeholders beyond HE representatives. While the Innovation Council has only government representation, other existing bodies identified in the previous footnote quite often have a broad range of people from universities but rarely have people from key stakeholders: business, industry and civil society.

Despite multiple government agencies and advisory and representative bodies, the system shows a deficit of stakeholder involvement[8], unclear aligning of strategies (other than at the level of strategy for responsible development) **and priority-setting** for R&I (as evidenced in the multiple priorities of different strategies) and human capital development. **There is also room for developing strategic intelligence based on foresight and evaluation practices[9]**. Stronger alignment would require inclusion of all relevant sets of stakeholders, which depends on transparency and communication of their rationales, goals and objectives for agreeing priorities and implementing the resulting activities. The National Science Congress has provided a welcome opportunity to bring together HE stakeholders to discuss the main building blocks of the HE reform package, such as internationalisation, excellence, professional development or technology transfer. In the case of innovation policy, the Morawiecki's Plan was presented and discussed at 16 regional conferences, and the results were taken into account when preparing the Strategy for Responsible Development. Prioritisation, strategy formulation and implementation require adequate governance structures and processes that bring together 'top-down' and 'bottom-up' needs in priority-setting exercises involving actors at different levels.

2.4 Higher education institutions and students

Poland's large HE system is contracting but remains fragmented into a few big and many very small institutions. Demographic decline is impacting the HE system and reducing the number of HEIs mainly in the non-public sector. From 2010 to 2016, the number of HEIs fell from 460 to 415[10]. The public HE sector, with 132 institutions, dominates in terms of student numbers: in the academic year 2014/15, over three-quarters of students were enrolled in public universities, with the 10 largest public universities accounting for 23 % of students (GUS, 2015e).

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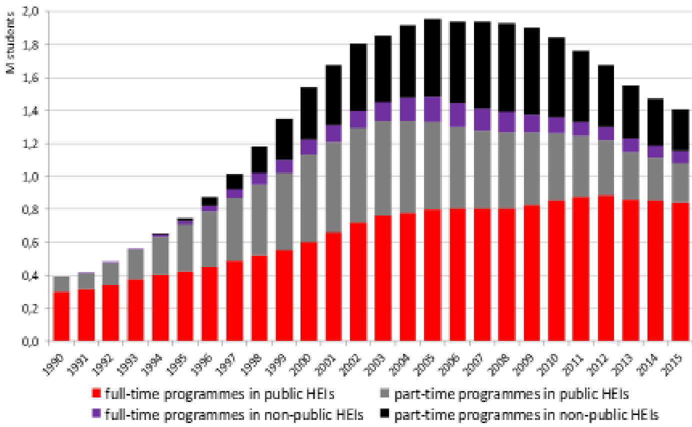
8 Klincewicz & Marczewska (2017) refer to a lack of stakeholder involvement in consultations on many programmes, instruments and priority lists due to lack of interest or understanding of the importance of such an involvement as well as generally weak sectoral representations of businesses, and "the passivity of ministries or agencies, which were contented working with a small, not always representative group of stakeholders".

9 In 2004-2013, foresight projects were carried out – i.e. three national projects and more than 20 regional and sectoral projects. After 2014, the foresight activities at national and regional levels have been included in the 'Entrepreneurial Discovery Process' and smart specialisation strategies. Foresight methods are implemented by some thematic groups established by the ministry of development according to the National Smart Specialisation Strategy.

10 The 415 institutions include: i) 283 mainly small non-public institutions of which 19 are universities, and ii) 132 public institutions, including 17 comprehensive universities, 45 specialised universities (technical, medical, economics, etc.) and around 30 highly specialised academies. The public HE sector also includes a 36 mainly small public higher vocational schools.

HE student enrolments are declining, and expenditure per student is low compared to OECD countries. In 2015, Poland's HE system enrolled nearly 1.31 million students (58 % women), 7 % less than in 2013 (see Figure 5). The gross enrolment ratio declined from 53.8 % in the academic year 2010/2011 to 49.2 % in 2013/2014.

Figure 5: HE student numbers, 1990-2015



Source: MNiSW

Poland benefits from the high tertiary education attainment of its young adults, but student demand in science and technology could be enhanced. The tertiary educational attainment rate for 30-34-year-olds has almost quadrupled in the last 15 years, standing at 43.4 % in 2015, which is significantly above the EU average of 38.7 % (EC 2016a). In 2015, Poland's HE system produced 395 200 graduates, with 64.8 % women (but only 1.8 % foreigners). While a quarter of graduates (98 000, 24.7 %) are in science and technology (45 % women), student demand focuses on social sciences, law and business (42 % of master's students in 2014, according to OECD data 2016).

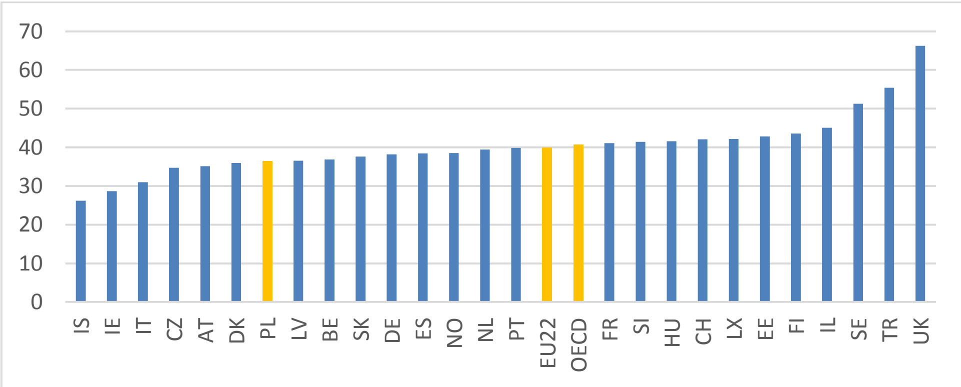
2.4.1 Higher education spending

Poland's expenditure on HE as a ratio of GDP is only slightly below the OECD average, but given the relatively low level of Poland's GDP per capita and the high number of students, the annual expenditure per student is extremely low. In 2013, Poland's total expenditure on bachelor's, master's and doctoral degrees was 1.4 % of GDP, compared to the EU average (EU-22)[11] of 1.5 % and OECD average of 1.6 %. Expenditure in HE per student, relative to per capita GDP, is lower than international averages (36 % compared to 40 % for the EU-22 and 41 % for the OECD average) but

[11] The OECD data covers information for EU-22.

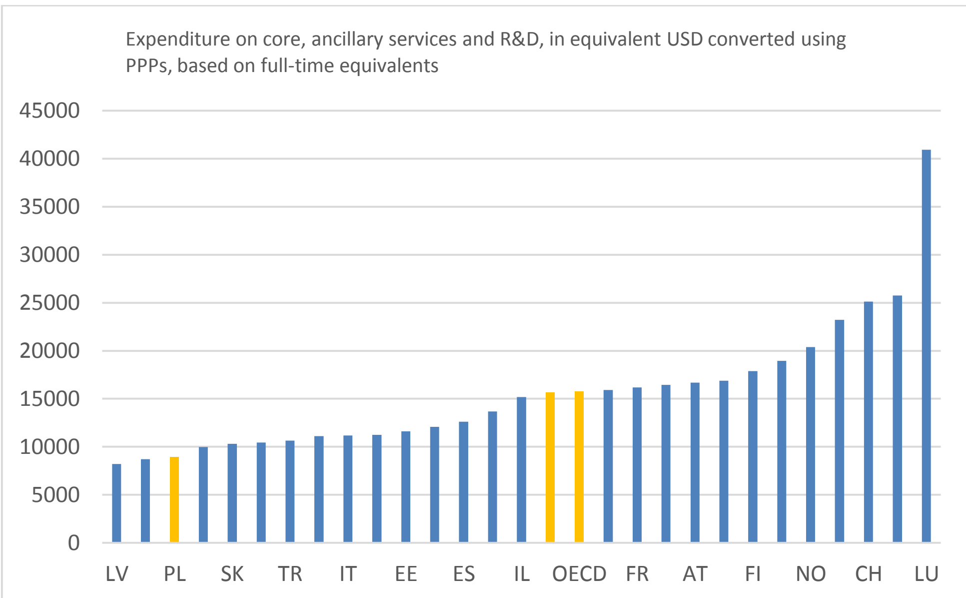
increased by 43 % between 2008 and 2013 (5 % in OECD)[12]. Based on 2013 data, the annual per-student expenditure in Polish tertiary education institutions was less than USD 9000 compared with EU-22 and OECD averages of about USD 15 700-15 800 (OECD 2016c). (HE funding issues will be discussed in Chapter 4.2).

Figure 6: Annual expenditure per student by education institutions for all services in tertiary education, relative to per capita GDP (2013)



Source: OECD Education at a Glance. Education Indicators 2016c. Page 195. Table B1

Figure 7: Annual expenditure in USD per student by education institutions for all services, in tertiary education in selected countries (2013)



[12] Based on 2013 data, the annual per-student expenditure in Polish tertiary education institutions was less than USD 9000 (USD 8929) compared to the EU-22 average of USD 15 664 or the OECD average of USD 15 772 (OECD EAG 2016).

Source: OECD Education at a Glance. Education Indicators 2016c. Author's own elaboration based on Figure B1.3, page 183
StatLink http://dx.doi.org/10.1787/888933397604
Note: Expenditure on core, ancillary services and R&D, in equivalent USD converted using PPPs, based on full-time equivalents

2.4.2 Declining demand for paid higher education is a financial burden on families and equity

Poland's HE system places a heavy financial burden on families, but offers limited financial assistance to disadvantaged students. OECD Education at a Glance (2016c) shows that families cover 18 % of expenditure on HE, more than in most countries where, in principle, it is free. Unlike countries where the burden on families is alleviated by public subsidies for student grants, scholarships and loans, Poland provides very limited support for this purpose with little effect on the redistribution of the cost of tertiary education. Student grants remain modest in relation to the cost of living, and the availability of loans is limited.

Students in part-time programmes in public institutions and non-public HEIs (25 % all HE students) pay fees. This may imply that the disadvantaged population subsidises the public education to which it has limited access: full-time study programmes in traditional public metropolitan universities are attended primarily by students of higher socio-economic status, while part-time, fee-paying students in public institutions come from less-affluent and less-educated families (Herbst and Rok 2011). Due to the lack of data on students' socio-economic background and institutional levels, it is difficult to evaluate the scope of this challenge and the need for student support.

The demographic decline reduces the demand for paid educational services in public and particularly in the non-public HE sector. In 2013-2014, the student population in non-public higher education declined by 13 %, compared to 5 % in public universities. The number of full-time students is almost double the number of part-time students. The part-time student population has declined over the last two years by 17.5 %, compared to a 0.8 % reduction in full-time students. In public universities, the number of full-time students is 3.5 times higher than the number of part-time students, while in private universities the situation is reversed. In 2015, private universities recorded a negative net result for the first time.

2.4.3 Labour market relevance

The employment of recent HE graduates is above the EU average, but there are growing concerns about labour market mismatches. In 2015, the employment of recent tertiary graduates in Poland stood at 85.1 % compared to the EU average of 81.9 %, but a substantial and increasing number of tertiary education graduates are in medium- or low-skilled jobs, which points to labour market skills mismatches (EC 2016a). Nonetheless, the extent of 'over-qualification' remains significantly below the EU average, as evidenced by recent studies (Cedefop 2015).

Despite variations across HEIs, public higher education provision remains academically driven and weakly aligned to the needs of the economy. Few undergraduate and graduate students benefit from multidisciplinary studies (4 %), new disciplines or pedagogies. The design and delivery of study programmes tends to be supply-driven, based on the academic capacity of HEIs and their teaching staff rather than the needs of the economy, which is partly due to the lack of formal representation of external stakeholders in the governance of public universities. Because of the limited focus on transversal and employability skills, students may need to undertake additional (paid) training outside the HE system, for which they do not receive credit. The university careers services have benefited from EU support and could play an important role in linking students to the labour market. However, they are often poorly connected to academic departments, and depend on project funds. The majority of students choose the traditional academic route following bachelor's and master's pathways; three-quarters (77 %) of those obtaining a tertiary degree graduated with a master's or equivalent (OECD 2016d). Early specialisation acts as a barrier to in-country, international and cross-sectoral mobility, providing monolithic blocks of subjects that run from the first year of bachelor studies to the last year of PhD studies. Doctoral training is mainly traditional and industrial PhDs have only just been launched (see, for example, Puukka et al. 2013).

A major shortcoming in the Polish HE system is the underdevelopment of vocational HE which does not attract students. Poland has one of the lowest percentages of young people expected to graduate from short tertiary education programmes during their lifetime (0.5 %, ranking 29/32 OECD countries) (see OECD 2016c). **The 35 public higher vocational schools (PWSZ) have a special role in regional development and an obligation to include regional representation in their governance, but their results are limited and uneven across institutions.** Unevenly spread across Poland, the sector suffers from rapidly declining student enrolment and frequently offers low-cost learning programmes which are weakly aligned with local needs. Graduate employability shows mixed results across institutions, depending on the education offer and its alignment with the local needs[13]. There is a lack of systematic inclusion of work-based learning opportunities in the PWSZ study programmes. **Current plans to reform the PWSZ sector imply mandating institutions to offer practical training opportunities and allowing institutions to transform towards a dual university model alternating work-based learning with studies** (see Chapter 3.1.2. for more details).

The Polish authorities have implemented new funding formulae for academic and vocational HEIs to improve the quality of HE, as well as competitive project-based funds to address these challenges. A new algorithm for financing HEIs was launched in January 2017, which aims to strengthen the incentives for teaching quality (see Chapter 4 on funding). The

[13] PWSZ students mainly pursue studies in social sciences (5525 students) and medical science and health sciences (4022 students). Graduates in social sciences face double the risk of unemployment compared to graduates in health-related fields.

MNiSW and NCBiR[14] have also launched competitive calls to improve the quality of teaching in HE, labour market links, graduate employability and entrepreneurship[15]. A NCBiR programme aims to develop relevant skills for the labour market through certified classes and workshops, project work, company visits, and cooperation with foreign institutions and social partners. Other competitive calls financed through the European Social Fund aim to provide services for students, such as career coaching, assistance for start-ups and entrepreneurship education (EC 2016a) (see also Chapter 4.2. on funding).

The MNiSW has made commendable efforts to enhance the focus on graduate employability by introducing a graduate-tracking system and developing user-friendly support for potential students to guide their study and career decisions. Based on administrative data from the social security system and information from the ministry's student database, the ELA system[16] generates anonymised aggregate reports for annual graduate cohorts according to HEI and type of studies. The first reports were published in May 2016 and are available in Polish only. In June 2017, a new search tool – 2015 rankings – was introduced offering a user-friendly tool to compare graduate employment outcomes (gross salaries, duration of job search, etc.) across study fields, disciplines and institutions. Currently, the national system provides data and reports on graduates for 2014 and 2015. The system will provide analysis of labour market outcomes one, three and five years after graduation. Additional tracking is carried out by HEIs as part of their internal quality assurance systems.

2.5 Science system

The public science system is an important R&D performer in Poland but its potential is constrained due to the system's fragmentation and low levels of spending. The public science system comprises hundreds of HEIs and PROs, mainly small and narrowly focused institutions, each with differentiated research interests. Compared to benchmark countries in Europe, investment in public science is low for both institutions and personnel (see table 1. for more details on funding).

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[14] National Centre for Research and Development (NCBiR) finance applied research and innovative development, including business enterprises' R&D projects.

[15] The NCBiR-coordinated POWER programme supports HE and teaching initiatives: New Teaching Programmes for labour market relevant studies and Competence Development Programme for HEI staff.

[16] http://absolwenci.nauka.gov.pl

Table 1: Main R&D indicators – government

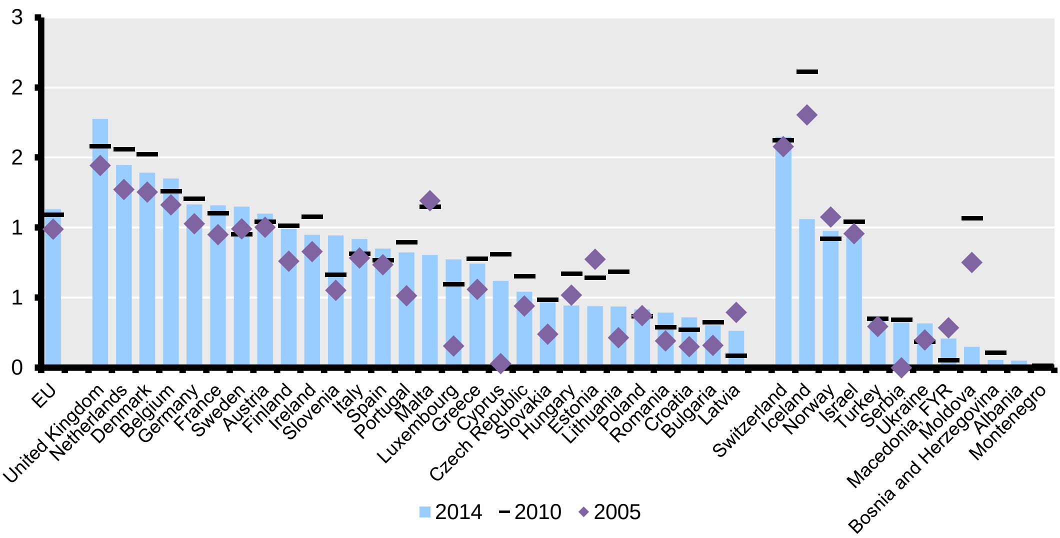
Indicator/inputs & outputs	2010	2012	2014	2015	EU average*
Total GBAORD (EUR million)	1313.6	1370.1	1767.8	1754.0	96081.9
Total GBAORD (as % of GDP)	0.36	0.35	0.43	0.41	0.65
Total civil GBAORD (EUR million)	:	1272.1	1683.4	1665.3	91439.4
Total civil GBAORD (as % of GDP)	:	0.33	0.41	0.39	0.62
R&D funded by Gov (% of GDP)	0.44	0.45	0.43	0.42	0.66*
R&D performed by Gov (% of GDP)	0.26	0.25	0.23	0.24	0.24
R&D performed by HEIs (% of GDP)	0.27	0.30	0.27	0.29	0.47

Source: Eurostat data -EC RTD Unit for Analysis and Monitoring of National R&I policies
* EU average refers to 2014

Poland's performance is modest in scientific outputs and it lacks international visibility. Poland scores low in the European Innovation Scoreboard, including a poor ranking for research outputs and low shares of highly-cited publications in comparison with other EU Member States (see also Figure 8). With only 4.9 % of Polish scientific publications among the 10 % most-cited worldwide, Poland ranks 24th in the EU, ahead only of Croatia, Latvia, Lithuania and Bulgaria. Some HEIs do not carry out any internationally recognised research and have insignificant numbers of foreign peer-reviewed publications. Some research institutes do not pursue globally impactful scientific research. Only two Polish universities out of over 300 HEIs – Jagiellonian University and University of Warsaw – were included in the 2016 ARWU World University Ranking of 500 best universities (Shanghai Ranking, 2016), and both were in the last 500 (see also Chapter Six on internationalisation).

According to the EC analysis (EC 2016b), Poland is among the countries which are clearly underperforming in terms of scientific quality, given their public R&D investments. The report 'Science, Research and Innovation Performance of the EU 2016' shows that, unlike countries such as Austria, Belgium, Sweden and Denmark, which actively participate in international scientific networks, Poland, Romania, Croatia and Latvia still produce their scientific outputs mainly at the national level. Given the clear correlation which exists between the openness of R&I systems and the quality of scientific results, countries, like Poland that are still not taking full advantage of international scientific networks "should further open their national R&I system in order to increase their overall scientific performance" (EC 2016b).

Figure 8: Highly cited scientific publications (1), 2005, 2010 and 2014



Source: EC (2016b) Science, Research and Innovation performance of the EU 2016;
DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: Eurostat, World Bank, CWTS base on Web of Science database
Note: (1) Fractional counting method. (2) Citation window: publication year plus two years research quality is evaluated in the Comprehensive Evaluation of Scientific Units which is conducted every four years. The best-performing research units receive the A+ or A research category, good ones B and the least performing, C (see Chapter 4.4. for a full analysis of the evaluation system). The research category impacts public funding allocation to the unit (see Chapter 4.2.2).

As a result of the suboptimal outcomes of this fragmented public science system, the Polish government plans radical reforms focusing, on the one hand, on the reorganisation of the HE sector and, on the other hand, on setting up an organisation which will bring together some of the research institutes while the rest will be incorporated into universities, converted into "commercial" public companies, or closed[17]. Immediate plans have not been made to reform the PAN institutes, although the Academy has embarked on an effort to re-establish itself as an independent research-intensive university. Aspects of HE and science landscape reform are discussed in Chapter 3.

[17] The plans in this respect are evolving. During the review visits in March and June 2017, the government was envisaging the establishment of a Frauenhofer-type National Institute of Technology (NIT), but a more recent plan focuses on developing a network organisation ('Research Network Lukasiewicz'). Earlier plans included incorporating some of the research institutes into an umbrella organisation, and others into universities, while the rest would either be converted into 'commercial' public companies or closed down.

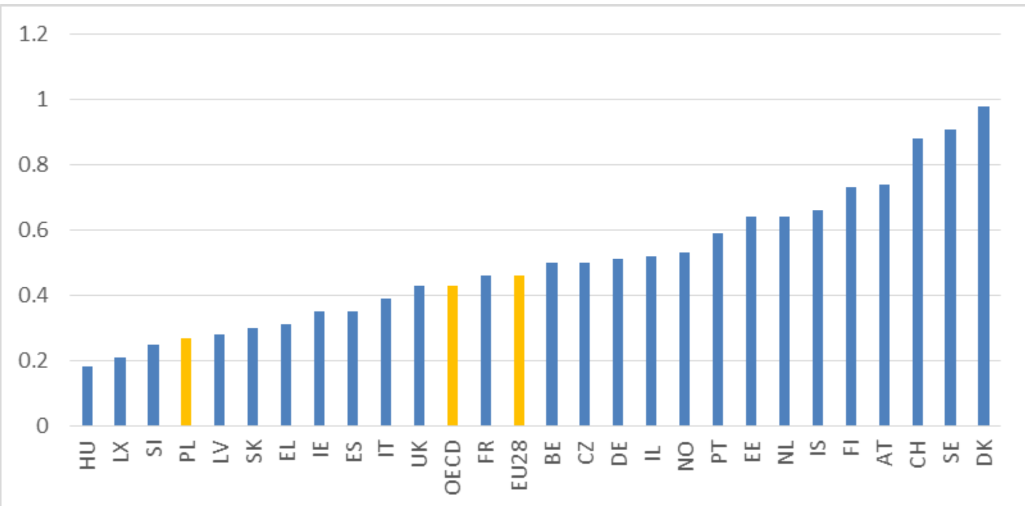
2.5.1 Universities

Universities are major actors in the science and research system in Poland, but due to the fragmentation of the HE sector, research is dispersed within and between institutions with few pockets of excellence. In 2014, 108 out of 132 public HEIs and only a few non-public HEIs pursued R&D activities. Over 280 scientific units within HEIs have achieved the high-quality category (A+ or A).

Although higher education R&D expenditure (HERD) in Poland is low at less than half the OECD and EU average, it is growing. In 2014, HERD amounted to PLN 4710 million (EUR 1125.6 million), with an increase of 21.7 % from 2010. Poland's HERD as a percentage of GDP was 0.27 % (up from 0.18 % in 2005), behind the OECD and EU-28 averages (0.43 % and 0.46 %, respectively) (see Figure 9). Over 70 % of HERD is focused on fundamental research (71.4 %) and is mainly funded by the government or the EU: in 2014, 73.1 % of HERD was funded by the government, 16.6 % by foreign sources, notably the European Commission, and 7.3 % by universities' own financing. Only 2.8 % of HERD was funded by domestic business enterprises, and 0.2 % by private non-public organisations (OECD 2016c).

Compared to other public science organisations, public HEIs registered the lowest levels of R&D expenditures per R&D employee: PLN 108.1 thousand (EUR 25.8 thousand) in 2014, compared with PLN 165.8 thousand (EUR 39.6 thousand) for research institutes and PLN 184.6 thousand (EUR 44.1 thousand) for PAN institutes.

Figure 9: HERD as a percentage of GDP (2014)



Source: OECD Main Science and Technology Indicators 2016/2

Table 2: Main R&D indicators - universities

Indicator/inputs & outputs	2010	2012	2014	2015	EU average (2014)
R&D performed by HES and funded by GOV (% of GDP)	0.2 %	0.22 %	0.2 %	0.19 %	0.37 % (2013)
R&D performed by HES and funded by private BES+PNP (% of GDP)	0.01 %	0.01 %	0.01 %	0.01 %	0.02 %
International scientific co-publications per million population	173.61	199.19	235.23	276.7 (2016)	493.6 (2016)
Scientific publications among the top 10 % most-cited publications worldwide as % of the country's total scientific publications	4.12	4.25	4.902	NA	11.004
ERC success rate (granted over evaluated)	0.1	0.04	NA	0.04	NA

Source: Eurostat (2016); Web of Science

2.5.2 Other public research organisations

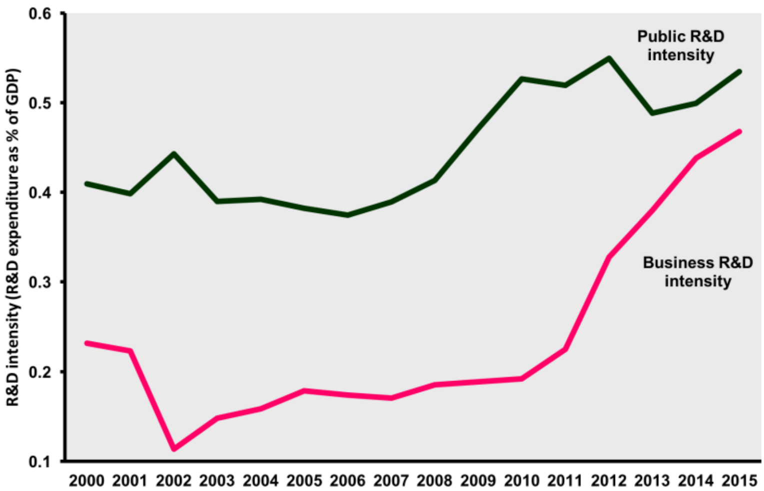
The Polish Academy of Sciences (PAN) encompasses 70 research institutes, most of them nationally leading institutions, including over 50 with an A+ or A research-quality status. Their focus is on basic research which covered 70 % of R&D expenditures in 2015. PAN is overseen by the prime minister, but receives its budget from the MNiSW. In 2015, PAN incurred PLN 1.68 million (EUR 394.2 million) of R&D expenditure and employed about 8100 R&D staff.

In addition, 114 research institutes (IB according to the Polish acronym) conduct mainly applied R&D and experimental research (82 % of R&D expenditure in 2015). Most of them are located in Masovia, in particular Warsaw which has 60 research institutes. Institutes are diverse in terms of focus areas, governance and research quality. They operate in all sectors of the economy, including public administration, and are supervised by 16 ministries. Over 40 have high research quality (mainly A category). Independent evaluation has highlighted challenges in many research institutes, including limited contacts with industry, suboptimal scientific performance, excessive reliance on government funding and ageing researchers. In 2015, research institutes invested PLN 2.57 billion (EUR 603 million) and employed 17 700 R&D personnel[18] (Klincewicz & Marczewska 2017).

2.6 Innovation in the economy

Business expenditure in R&D (BERD) has increased, thanks to larger firms and foreign-controlled companies, and business R&D intensity has also grown but lags behind internationally. In 2015, Poland's R&D expenditure in the business sector was 0.44 % of GDP, up from 0.22 % in 2011, but significantly below the EU average of 1.3 % and the national target of 0.85 % by 2020. Since 2011, business R&D intensity has grown, approaching the public R&D intensity (see Figure 10). Corporate R&D spending has more than doubled since 2011, in national currency, but from a low base and at a slower pace than the availability of public co-funding from the NCBiR. In 2014, foreign-controlled companies accounted for 57 % of BERD, 44 % of business R&D personnel and 19 % of R&D-active firms. Between 2010 and 2014, the number of foreign-owned companies active in R&D more than doubled (from 214 to 511), and their R&D expenditures more than tripled to about EUR 908 million). In 2014, around 10 % of firms with R&D expenditure filed patent applications: domestic companies were more active than foreign-controlled firms (with only 5 % filing patent applications in Poland) (Klincewicz & Marczewska 2017).

Figure 10: Poland - evolution of business R&D intensity and public R&D intensity, 2000-2015

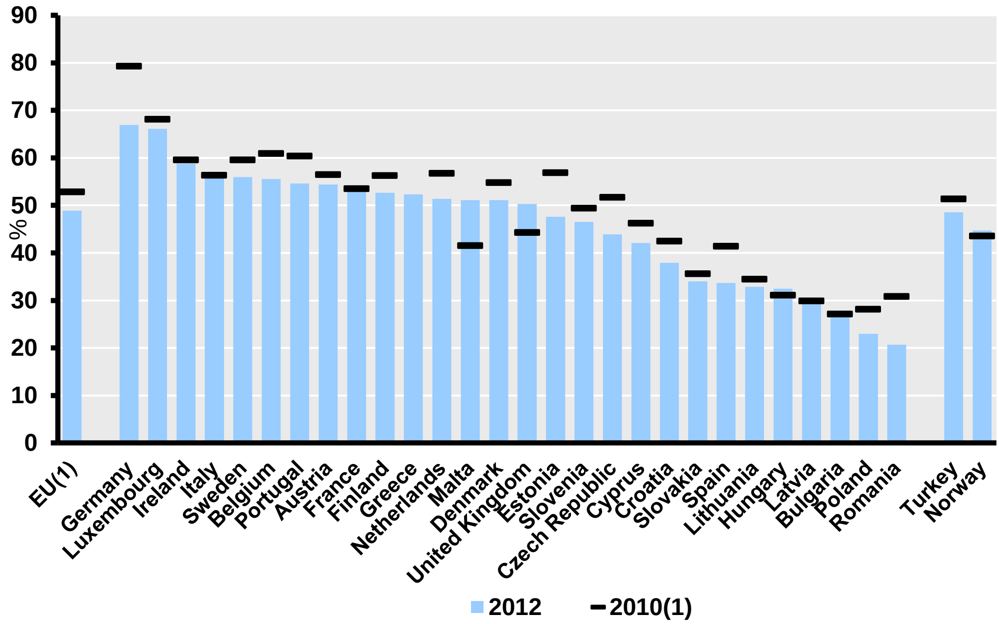


Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies, Eurostat
Notes: (1) Business R&D intensity: BERD as % of GDP. (2) Public R&D intensity: government intramural expenditure on R&D (GOVERD) plus HERD as % of GDP

[18] The total number of staff in research institutes, including non-research staff, is about 42 000 (2015), mainly in institutes supervised by the ministry of health which, in addition to research activities, provide medical services for operating large hospitals.

The number of private-sector R&D performers in Poland has risen gradually, but continues to trail behind the EU average. Medium- and low-technology companies still dominate in industry, with relatively low innovativeness. Innovative activities are limited to a small group of companies: in 2014, only 2814 from over 200 000 companies reported R&D activities. According to the EC analysis (EC 2016b) Poland, together with Bulgaria and Romania, has the lowest shares of innovative enterprises: the share of innovative enterprises declined from 2010 to 2012, with Poland scoring the second lowest rate in the EU area (see also Figure 11). According to the European Innovation Scoreboard (EC 2017b), Poland has the lowest rate in the EU at 10 % for SMEs that innovate in-house. Less than 4 % of innovative SMEs cooperate with other firms and/or research organisations in their innovation activities. According to Klincewicz & Marczewska (2017), many companies only embark on formal R&D projects if public co-funding and grants are available, while a small number of firms apply for H2020 funding or other international support. Many companies under-report their privately funded RDI projects[19].

Figure 11: Share (%) of innovative enterprises in total number of enterprises, 2010 and 2012

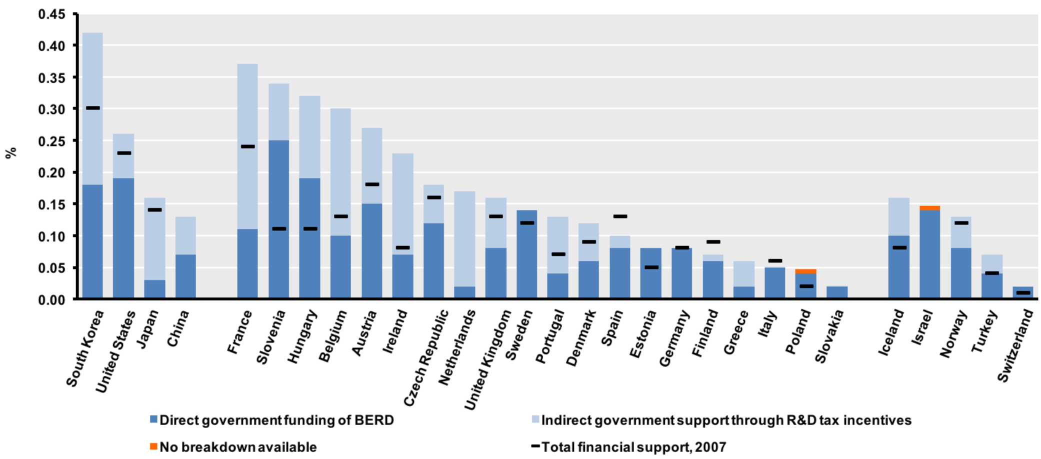


Source: EC (2016b) Science, Research and Innovation performance of the EU 2016; DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
Data: Eurostat (CIS 2010, CIS 2012)
Note: EU(1): Greece is not included in the EU value for 2010

[19] This situation was caused by the complicated tax and accounting regulations rather than the lack of tax incentives. However, both issues were tackled in 2015

Part of the challenge has been the limited public support for business (see Figure 12), although this has changed in recent years – for example, with tax incentives for science-to-business cooperation and innovative start-ups. Currently, Poland offers enterprises easy access to small loans and public financial support, including loans to finance technological innovations for SMEs. New R&D tax incentives were launched in 2016, including a 30 % reduction in R&D staff wages and 10-20 % in qualifying R&D costs, while new tax breaks will incentivise science-to-business cooperation. In June 2016, the government launched a support programme for innovative start-ups (#StartInPoland) which aims to create the largest venture capital investment platform in Central and Eastern Europe. New funding instruments will be launched at regional level – for example, regional business angel networks, mentoring for young entrepreneurs, and incentives to establish venture capital funds.

Figure 12: Public support for business R&D, 2007 and 2013



Source: EC (2016b) Science, Research and Innovation performance of the EU 2016; DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies Data: OECD (STI Scoreboard, 2015)

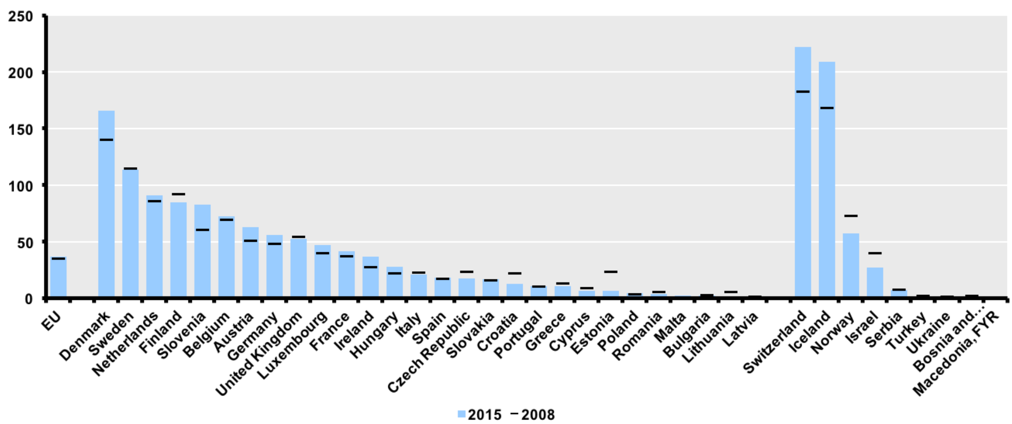
In relation to the ease of doing business, Poland has improved its ranking from 76th in 2009 to 25th in 2016 (World Bank 2016). In 2016, a new regulation package was launched concerning the relationship between the government and business enterprises: the 'Business Constitution' provides for a general plan for future business-law reform, including a forum for ministries and representatives of entrepreneurs.

The government's RDI policy, focusing on indigenous innovations and incentives to state-owned enterprises to engage in large R&D projects, can have unintended impacts. The shift in focus of public R&I funding is unlikely to generate short-term positive results given the limited absorptive capacity of state-owned companies. In fact, it may harm privately owned enterprises, which account for 88 % of BERD and 90 % of R&D personnel in the business sector (2014 data) and foreign-controlled R&D could move to other countries if framework conditions deteriorate.

2.7 Links between higher education, the science system and the economy

Business-science linkages remain underdeveloped in Poland. Only around 10 % of innovative companies cooperate with universities and HEIs. In terms of public-private scientific co-publications, Poland lags behind its regional peers, such as the Czech Republic or Hungary (Figure 13). While countries such as Switzerland, Iceland, Denmark, Sweden, the Netherlands, Belgium and Finland show strong science-business links and perform better than the United States, public-private co-publications remain marginal in Poland (EC 2016B).

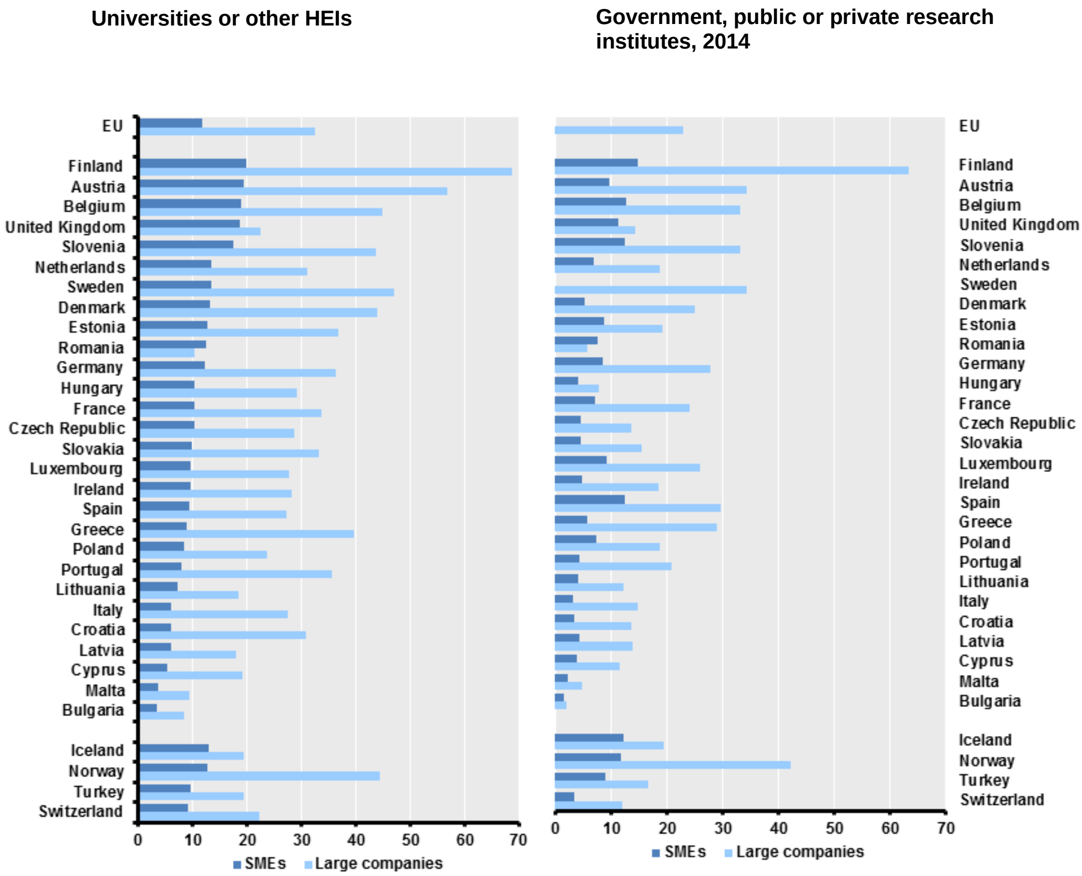
Figure 13: Public-private co-publications per million population, 2008 and 2015



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: EC 2017c; European Innovation Scoreboard
Note: (1) LV: 2013

Despite general low levels of industry cooperation, HEIs outperform other PROs in terms of cooperation with innovative enterprises and patenting: 16.8 % of innovative enterprises from the manufacturing sector and 11.9 % from the service sector cooperated with HEIs between 2012 and 2014. While these shares are low, HEIs outperformed PROs, including research institutes which were originally established to facilitate commercialisation (see Figure 14). HEIs also outperformed PROs and businesses in patenting: 27.2 % of HEIs performing R&D filed patents in 2014, compared to 19 % of PROs and 9.9 % of companies (Klincewicz & Marczewska 2017). In 2015, among all the PROs (367), four technical universities achieved the highest number of patents (429). Many patents have not been commercialised.

Figure 14:Enterprises cooperating with research organisations, 2014



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies Data: Eurostat (CIS 2014

Investments in technology transfer intermediaries have been spread across Poland. Between 2007 and 2013, the EU Structural Funds financed science or technology parks, entrepreneurship incubators, technology transfer offices and innovation brokers, while ESIF financing is currently being used to promote linkages and knowledge transfer intermediations. In 2014, there were 681 active business and innovation centres (BICs) in Poland (see Figure 15). These included: 42 science and technology parks, 24 technology incubators, 24 incubators operated by the Foundation of Academic Entrepreneurship Incubators (AIP), 42 technology transfer centres, 47 innovation centres, 103 equity funds, 81 local and regional loan funds, 58 credit guarantee funds, 7 business angel networks, 207 training and consulting centres, and 46 incubators (Gulda et al. 2017). Many publicly funded technology parks are half-empty and cater for non-innovative tenants, while new technology-based firms use privately funded co-working spaces (see, for example, Klincewicz & Marczewska 2017).

Figure 15: Regional distribution of BICs in Poland

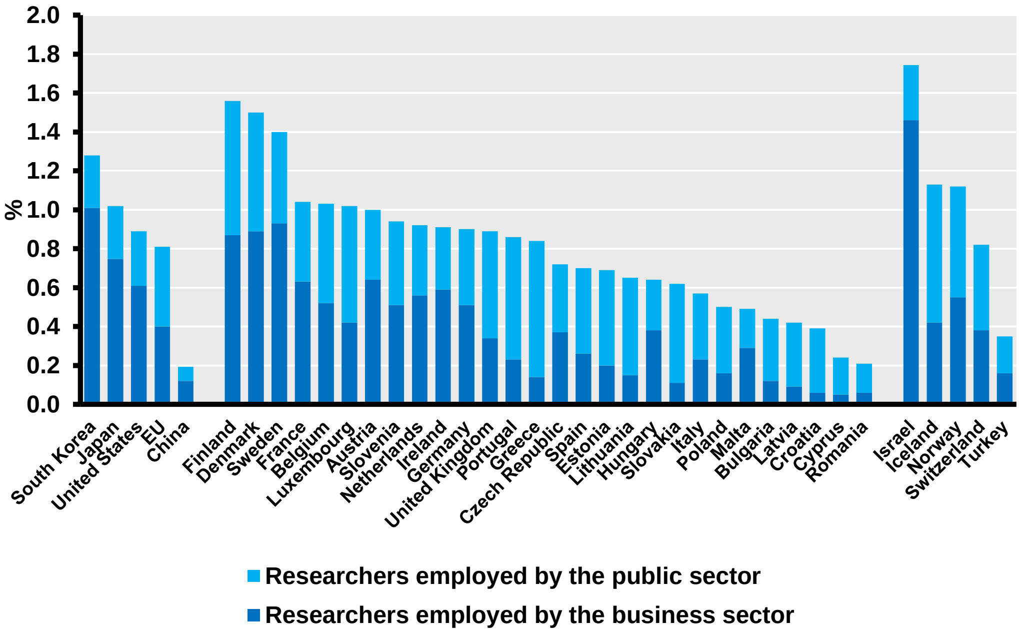
Source: Gulda et al. 2017 based on SOOIPP, 2015

2.8 Human resources for research and innovation

Poland performs above the EU average in the EU headline target on the tertiary attainment of 30-34-year-olds. In 2015, 43.4 % of the Polish population aged 30-34 had completed tertiary education, above the EU average of 38.7 % (EC 2016a).

In terms of R&I human resources for research, Poland performs weakly with a low share of researchers. In 2013, Poland had 104 000 R&D staff. ranking 25th in the EU in terms of FTE jobs in R&D per 1000 employed people. Figure 16. shows Poland's low share of researchers out of the total employment, with the majority in public-sector jobs.

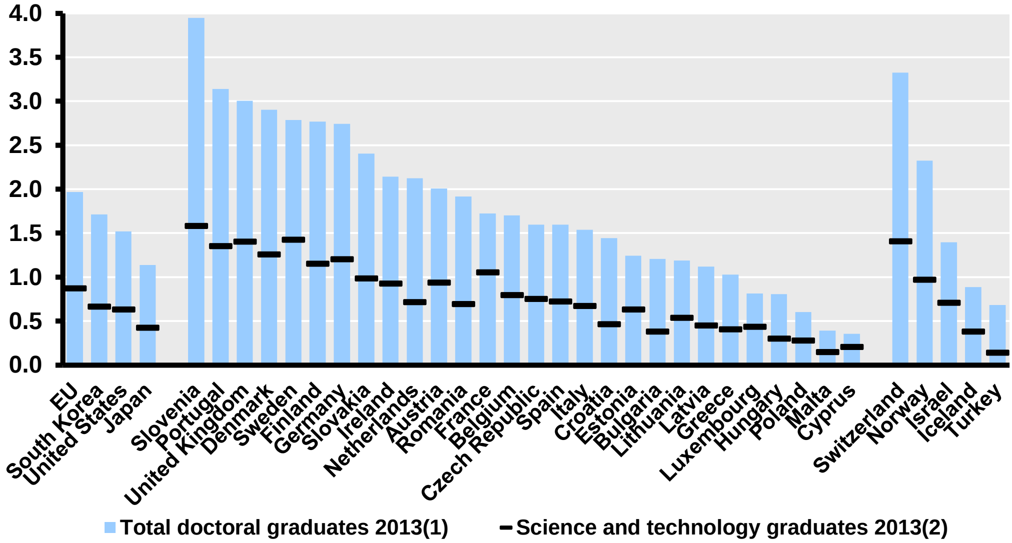
Figure 16: Total researchers (FTE) as % of total employment, 2014(1)



Source: EC (2016b) Science, Research and Innovation performance of the EU 2016. DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
Data: Eurostat, OECD
Note: (1) IL, CH, US: 2012; IS, TR, JP, CN, KR: 2013

There is also a low output of young PhDs due to the inefficient doctoral training system which fails to supply the advanced human capital that Poland needs to satisfy its ambitions as a knowledge economy. The number of doctoral candidates grew steadily to nearly 43 000 in 2015, but Poland is among the four weakest EU countries when it comes to generating new young PhD graduates: 0.6 PhD graduates per 1000 population aged 25-34, one-third of the EU average (1.8) (EC 2017b). Half of the doctoral candidates are not actively pursuing their studies. The PhD graduation rate is low and most doctoral studies are prolonged. The graduation age is high compared to the OECD average (see also Chapter 4.3.1).

Figure 17: New doctoral graduates per thousand population aged 25-34, 2013



Source: EC (2016b) Science, Research and Innovation performance of the EU 2016. DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
Data: Eurostat, OECD
Note: (1)IS, IL: 2012. (2)PL: 2009; IS, IL: 2012

Although gender equity in HE and science has improved significantly, women remain under-represented among academic staff in Poland, especially in the higher ranks. Compared with the OECD and EU countries, in 2014, Poland had a large share of female graduates from doctoral or equivalent programmes (53.6 %, OECD rank 6/40). According to the OECD Education GPS data, the proportion of female tertiary graduates in sciences was one of the highest among OECD and partner countries (47.7 %, rank 6/42)[20]. Poland is also ahead of the EU in terms of share of female researchers (over 37 % in Poland in 2014 vs. around 33 % in the EU-28, 2013). Despite a substantial increase in the share of female academic staff during the last 15 years, women remain under-represented among academic staff. The gap between men and women widens with rank, with women having the highest shares among the lowest ranked and the lowest paid positions. In 2014, the share of habilitation degrees awarded to women was 40 % and the share of professor titles to women was 33.7 %. In 2013, women held 48.3 % of PhD titles, 33.6 % of the Dr hab. titles and 22.6 % of the professor titles (EC 2016c). Research teams lead by male professors also have a better chance of obtaining research grants in all disciplines (see Chapter 4.3.3).

There is a relatively small number of outstanding researchers in most fields of science and technology in Poland, along with a substantial number of low-performing scientists, which manifests itself in the

[20] http://gpseducation.oecd.org/CountryProfile?primaryCountry=POL&treshold=10&topic=EO (accessed 5 August 2017)

distribution of national grants from the NCN, the Foundation for Polish Science (FNP) and Horizon 2020 (including ERC grants, dominated by the University of Warsaw, as well as publication patterns in the most prestigious international journals (Klincewicz & Marczewska 2017).

Poland's R&I system is challenged by the rigid rules governing career progress, while incentives for research careers remain limited. Rigid rules on career progress make the system less attractive to both domestic and foreign talents. The age structure of R&D staff is also cause for concern, along with the relatively late age of achieving autonomy in research. Interinstitutional and intersectoral mobility among R&D staff is discouraged by career progress regulations. The average level of academics' salaries is modest and performance-based differentiation of remuneration and career progress remains a mandatory but underdeveloped tool (see Chapter 4.3.2. for more information).

The Polish HE system is academically oriented with a weak development of entrepreneurial spirit. A typical academic career trajectory in Poland is based on generating publications rather than commercially viable solutions, with limited attention paid to the societal or economic impacts of the research (Klincewicz & Marczewska 2017). Public support for measures targeting HEI and PRO staff such as the 'Top 500 Innovators' and 'Transformation.doc' support schemes have trained young scientists and research administrators, exposing them to innovation ecosystems abroad and promoting best practices related to technology transfer and cooperation with industry. However, the impact of these investments may be lost if people leave Poland because of the lack of attractive career opportunities.

3 REFORM OF THE POLISH HIGHER EDUCATION AND SCIENCE LANDSCAPE

Before launching into the review of the key instruments the government can use to steer the HE and science system (governance, funding, quality assurance, human resources and career system, industry-academia connections and internationalisation, as covered in the following chapters), the focus here is on four key aspects of the reform of the institutional landscape of the future Polish higher education and science system, according to the panel members. It also presents the panel's views on these four aspects which were identified in documents it received and in its interviews in Warsaw in March and June 2017.

- The proposed diversification of HEIs with the original idea of developing three types of institutions: research universities, research and teaching universities, and teaching (vocational) institutions;
- The selection of a small group of flagship research universities supported by large multi-annual grants to create scientific excellence with the aim of improving Poland's visibility in international university rankings;
- A reduction in the number of HEIs through a process of consolidation, restructuring or streamlining:
- The future or public research institutes outside the university sector:
  - The reorganisation of Poland's public research institutes; and
  - The possible integration of the strongly performing research institutes of the PAN into research-intensive universities.

3.1 Diversification of higher education institutions into three institutional types

One of the major policy changes in the planned reform of the HE and science system concerns diversifying the HEIs. The original plans presented to the panel focused on developing three types of institutions: research universities, research and teaching universities and teaching (vocational) institutions. The broad context of this reform and of the planned Law 2.0 on higher education is outlined in Chapter 1.2 above.

The expectations of the MNiSW during the review visits was that by 2021 there would be up to 10 research universities (including three to five flagship universities), 80 research and teaching universities, and 35 teaching institutions in the public sector. These numbers are likely to be reduced by the institutional consolidation process (see Chapter 3.3 below). In addition, it is anticipated that there will be around 30 non-public research and teaching universities and 100 non-public teaching institutions, which is considerably fewer than the 283 non-public HEIs today. A major restructuring of the non-public HE sector through mergers, takeovers and closures is predicted.

3.1.1 Options for the diversification process

In HE landscape reforms, the selection criteria, classification process and the permeability of the boundaries between the different sectors are critical issues. The reform proposals put forward by three groups suggested different approaches. Kwiek et al. (2017) in their Law 2.0 proposal envisage a process driven by increased and differentiated funding that will lead to institutions determining their own places in the new landscape. After a transitional period, these places would be 'ring-fenced'. Another option would be centrally set criteria such as the current research unit evaluation scores (the proportion of A+ and/or A scores at an institution) as proposed by Izdebski et al. (2017) in their Law 2.0 report. (See Chapter 4.4 for an explanation of the current research unit evaluation system.) International experience in most countries with more than one type of HEI suggests that (semi-) permanent boundaries will be needed to achieve the desired outcome and to mitigate the risk of academic drift whereby most Polish universities might continually strive for research university status at the expense of their regional missions.

In the following section, **the panel proposes that a strong vocational HE sector (universities of applied sciences) should constitute an important element of the future Polish HE landscape. This would mean developing a robust HE binary system.** In the remainder of this section, the panel considers whether the universities should be further divided into research universities and research and teaching universities. (The panel's view is that the universities of applied sciences would fill the role of public teaching institutions, as foreseen in the Law 2.0 reports.)

As already indicated, Law 2.0 discussions during the time of the review visits envisaged the legislative enactment of a "trinary" system based on a set of criteria that had not been finalised. The MNiSW foresaw a fairly small group of research universities with most institutions falling into the research and teaching category, and a group of teaching-only institutions. Alternatively, the panel proposes **a competitive process through which a set of research-intensive universities are awarded significant additional multi-year funding to boost their research capacity and performance. A good example of such a process is the German Excellence Initiative** (see Learning Model 4.6.2 on the German excellence initiative).

The panel believes that the best method of selecting excellence-initiative universities is a high-level international peer-review-based selection process. While the assessment of research performance and impact would be at the heart of such a process, the criteria should be broader than the current research unit evaluation system which has recognised limitations (see Chapter 4.4). The attraction of an excellence initiative is that it does not require Poland's universities to be split into research universities and research and teaching universities. They would all remain universities and would retain a significant teaching function but would operate at different levels of research intensity. (This would also be the case for research and teaching universities in the three-sector model, as there is no intention to relocate all A+ units to the research university sector – "islands of excellence" would remain.) Those selected for the excellence initiative would have access to a significant additional source of competitive research funding over a multi-year period and would be steered through a multi-year contract with the MNiSW that would include performance benchmarks and targets. Such an excellence initiative, tailor-made for Poland, would be a lighter policy tool that is more flexible and easier to adapt to changing circumstances than the legislative enactment of a trinary system. The outcomes would be the same as those envisaged for research universities in the Law 2.0 discussions: a small group of research-intensive, internationally competitive Polish universities.

3.1.2 The case for vocational higher education

A major shortcoming of the Polish HE system is the underdevelopment of vocational higher education. One of the key findings of the 2007 OECD review was the need for a clear policy for this sector: "If we were to single out one key issue on which a clear policy is urgently needed, but simply does not exist at present, it would be the role of vocational education at the tertiary level … there is no clear and positive vision for vocational tertiary education, and the main aspiration of the existing 'vocational' institutions is to leave the sector and join the overcrowded ranks of the 'academic' institutions, where few if any of them can ever hope to emulate the established leaders" (Fulton et al. 2007). The situation has not changed significantly over the last decade.

Classifying institutions as teaching institutions will not in itself create a clear and positive vision for vocational higher education nor a wide range of vibrant career-focused programmes well-connected to labour market needs and embracing modern creative approaches to teaching and learning. The panel's view is that the creation of a modern university of applied sciences (UAS) sector in Poland is the structural reform needed to achieve these objectives. Teaching colleges offering traditional academic bachelor degrees are not what Poland needs to develop an effective mass HE system aligned with the socio-economic demands, needs and aspirations of a diverse student population. The MNiSW's current plans centre around mandating higher vocational schools to offer practical internships financed by the state, and allowing them to develop towards a dual university model alternating training between the work place and the institution.

The panel believes that Poland should have greater aspirations for higher vocational education and that the development of a modern UAS sector should be the target of a major new funding programme. The development of this new sector, including dual universities, is an area where Poland could cooperate with EU countries that already have strong UAS sectors. A robust UAS sector should have a strong presence in Poland's major cities (and not just primarily in the previous regional capitals), which will require new institutions, the modification of institutional missions and/or the establishment of institutions which would include both university and UAS programmes and schools (as, for example, in Australia, South Africa and Portugal). All of these possibilities will involve major change management and staff development challenges.

The panel recommends that Poland sets testing targets for the sector: for example, by 2027, 20 % of HE graduates should come from UAS programmes (6.4 % in 2015)[21]. **In addition, the panel recommends that the government carefully investigates the development trajectories of dual universities in different socio-economic contexts in Germany,**

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[21] Although business schools and business programmes in Poland are sometimes regarded as "vocational", the target referred here concerns graduates of UAS programmes.

including the leading institution DHBW, but particularly the DHGE in Thuringen in Eastern Germany**.** (See Learning Model 4.6.1 on Universities of Applied Sciences in the Netherlands and 3.6.2 on Dual Universities; see also Box 5.4. in Chapter 5.1. Higher vocational schools in regional development.)

3.1.3 The keys to developing a successful diversified higher education system

The keys to establishing and maintaining a successful diversified HE system, as outlined in the previous two sections, are governance, funding, human resource management, and institutional evaluation and programme accreditation criteria *that are all mission differentiated.*

In terms of differentiated missions, the reform proposals invited by the Polish government come to different conclusions (see also Chapter 1.1.). Citizens of Academia[22] (Radwan et al. 2017) have characterised the three proposed sectors as follows: "the emergence of universities operating for the needs of local communities; supra-regional universities; and universities competing with foreign universities". The Kwiek et al. (2017) report suggests different modalities for the three sectors' relationships with the academic, economic and societal environment:

- Research universities to focus on scientific excellence;
- Research and teaching universities on teaching, research and third-mission activities, in particular regional development;
- Teaching institutes on the teaching mission, the provision of universal access to HE and cooperation with the labour market in shaping programmes.

This is reflected in different compositions for external members of the proposed boards of trustees for institutions in the three sectors, as suggested by Kwiek et al. (2017):

- For research universities, primarily the scientific community – including those from outside Poland but also industrial users of scientific research;
- For research and teaching universities, stronger links with the regional socio-economic environment;
- For teaching institutes, no boards, although labour market representatives should be involved in programme development but not overall supervision; however, Kwiek et al. (2017) do not rule out boards for this sector.

The panel agrees that **the nature of the external stakeholders on the boards of trustees should be appropriate to the mission and profile of the institution and emphasises that all institutional types should have a board**.

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[22] The Citizens of Academia (Obywatele Nauki) is an informal and non-political social movement of academics and researchers discussing challenges of the Polish HE and science system.

In terms of funding, human resource management and institutional evaluation, and programme accreditation criteria, it is essential that the broad policy frameworks set out in Chapter four of this report are implemented in a differentiated way that is sensitive to the different missions, contexts and needs of Poland's diverse set of HEIs.

Table 3 gives some examples of how this differentiated approach might be implemented at three public HEI with different missions.

Table 3: Examples of differentiated policy approaches in diverse institutions

Policy domain	University of applied sciences	Regionally orientated university	"Excellence initiative" university
Primary mission	Career-focused 1st-cycle programmes closely linked to local labour market needs; Third mission linked to local labour market and community development.	Regionally relevant 1st- and 2nd-cycle programmes and "Islands of Excellence"; Third mission linked to regional development.	Internationally competitive research, PhDs and research masters; Third mission linked to knowledge exchange in leading edge RDI.
External members of board of trustees	Key local employers; Major secondary schools.	Key regional economic sectors; Senior regional/local officials.	International researchers; Large knowledge-intensive companies.
Funding	Basic core funding (input and output); Teaching and learning development grants; Competitive funding for practice-based applied research; Third-stream income.	Basic core funding (input and output); Teaching and learning development grants; Competitive regionally administered funding for research and applied research; Competitive national research funding (for "islands of excellence"); Third-stream income.	Basic core funding (input and output); Competitive national and international research funding; Competitive excellence initiative multi-year funding and contracts; Third-stream income.
Human resources	Institutionally developed, flexible academic workload policies that vary by individual (and over a career) and cover an institution's major activities. A (sectoral) career structure that provides for career development and progression based on transparent criteria linked to individual work profiles.		
Institutional evaluation/performance criteria	Graduates and employment; Local impact; Practice-based applied research results.	Graduates and employment; Regional impact; (Applied) research performance.	Graduates and employment; Research performance; PhDs produced; External research income generated; International peer review.
Programme accreditation criteria	Designed in partnership with local industry; Including work placements; Staff with relevant work experience; Facilities for project-based learning	Institutional capacity relevant to the programme; Regional relevance (but not exclusively).	Institutional (research) capacity relevant to the programme; National and international relevance.

Ideally, all institutions should see benefits for themselves in the major reform of the system, which will require a very careful allocation of the new funding to be injected into the system. New resources are needed for excellent research, for applied research and development, for developing innovative teaching and learning approaches and for stimulating the role of HE in regional development. This diversity in funding is essential if institutions are to diversify their missions. In addition to a win-win reform design and adequate funding, critical factors in the Polish HE reform are stakeholder engagement, a time frame, and monitoring and evaluation (see Box 3.1).

Box 3.1: The five critical factors in higher education structural reform processes

Recent research commissioned by the European Commission identified five critical factors that can facilitate successful structural reform processes in HE. (Please note that not all these factors apply to all structural reforms and that reforms can also fail for other reasons.)

1. Stakeholders' involvement and consensus. Implementation of the reform tends to be smoother and its operational goals achieved in cases where key stakeholders are involved in the design of the reform and/or consensus is built between the stakeholders concerning policy problems and solutions. In Poland, this will also imply engagement with regional governments.
2. Adequate funding and funding instruments. Reforms tend to work more effectively when there is adequate financial support, given the scope of the reform, and which enables a sustained effort over a realistic time frame.
3. Building a 'win-win' reform design. In an ideal situation, all HEIs have something to gain from the reform, or at least believe that they will not be disadvantaged.
4. A time frame for the implementation and evaluation of the structural reform which is commensurate with its scope and complexity.
5. Systematic monitoring and evaluation are valuable in supporting adaptation of the reform design and ensuring that it is in tune with the context of implementation.

Source: File et al. (2016) Structural Higher Education Reform – Design and Evaluation: Synthesis Report. European Commission (DG EAC), April 2016 (page 10)

3.2 Selection of a small number of universities as 'flagship universities'

If the goal is research excellence and concentration, then flagship universities are a strategic even if unpopular option for those not selected. Flagship units at the faculty/basic entity level will not propel their universities up the rankings and would run contrary to the stronger central institutional management proposed in Chapter four. The selection criteria, the selection process and the permeability of the boundaries between flagship universities and other universities are critical issues.

The selection of a small number (i.e. three) of flagship universities would need to be made from within those selected for the Polish excellence initiative, which should have a broader remit than just flagship universities. The selection of flagship universities should also be made by international peer review.

If the government decides to introduce flagship universities, the selection should be a competitive process launched towards the end of the first period of the new multi-year competitive funding for universities selected for the excellence initiative (around 10 universities). In other words, the panel envisages a two-stage competitive process: first, for selection for the excellence initiative; and second, towards the end of the first funding period, from within this group of universities for flagship status. The selection should be based on research performance and impact, including the results achieved through the new funding. The panel's view is that competition for flagship status should be reopened in each new funding period rather than awarding flagship status 'for life', even if the initial flagships will be in a strong competitive position[23]. Delaying the selection of flagship universities also allows for a period of potential institutional reconfiguration in terms of the consolidation processes, which could influence the selection of flagship universities. Learning Model 4.6.3 on the German Excellence Initiative could serve as inspiration.

The awarding of flagship status is likely to have a significant impact on institutional reputation. International experience suggests that status gained through research excellence is often generalised by students and other stakeholders to other aspects of a university's functioning, even when this is not justified. There is no reason to assume that flagship universities' performance in first-cycle teaching and learning is better than non-flagship universities. This would need to be assessed using different measures. However, many potential students are likely to make this assumption and it is probable that flagship universities will recruit the most talented bachelor students. **With this in mind, and in the interests of diversity and avoiding institutions being perceived by their peers to be "winning on all fronts", the MNiSW should consider a reduced or capped role for flagship universities in first-cycle education. In other words, there should be a limit on the number (or proportion) of bachelor and equivalent students they can enrol. This would also allow the flagship universities to concentrate more on their core business: excellent research, PhD education, and research master's programmes.**

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[23] In contrast, the panel thinks it is important that the group of excellence initiative universities should remain relatively stable: it should be possible to drop poorly performing universities from the group, while new universities should only be included in exceptional circumstances. If the competition is reopened for every funding period there is a risk of most universities continually striving for excellence-initiative status at the expense of their (regional) missions.

3.3 Reducing the number of higher education institutions through a consolidation process

With 415 HEIs, Poland has the third highest density per million of population in the EU after Lithuania and Portugal. A particular feature of Poland's institutional landscape is that 283 of the 415 institutions are mainly small and non-public of which only 19 have university status. These 283 institutions produced 106 000 graduates in 2015 or an average of 375 each. While having a large array of non-public institutions adds to system complexity and probably entails a regulatory premium, it does not represent an inefficient use of public funds. The MNiSW expects the number of non-public institutions to reduce significantly over the next five years – perhaps by half – as a consequence of the demographic decline.

At the same time, Poland's public HE sector is highly fragmented. Its 132 public HEIs include only 17 comprehensive universities. There is a relatively large number – 45 – of broad specialised universities (technical, medical, economics, etc.); a range of around 30 very specialised academies at least 20 of which produce less than 500 graduates a year; and 36 mainly small public higher vocational schools (PHVS) from which 18 000 students graduated in 2015, i.e. an average of 500 each. Therefore, some 50 public institutions have around 2000 students or less. Thus, the overall picture comprises a system of 415 institutions, most of which are small. See the maps below for the distribution of institutions and graduates by sector and region.

Figure 18: HE in Poland: distribution of HEIs by regions and graduates by sector and regions

Source: Jon File, 2015 HEI and graduate data from Central Statistical Office of Poland (GUS) http://stat.gov.pl

Another feature of Poland's public HE system is the concentration of institutions in the largest cities of its 16 regions. Excluding the higher vocational schools (35) and specialised academies belonging to other ministries, 79 of the 89 public institutions are in these 16 cities (see Table 4).

While having a large number of small institutions is not the most efficient approach, international experience suggests that the financial advantages of merger operations, if any, are likely to be realised only in the longer term. Mergers have the potential to create stronger, more sustainable institutions and a more 'steerable' system.

The future consolidation strategy should take advantage of the proximity factor and should aim to move from specialised institutions towards more comprehensive ones, with decisions made on a case-by-case basis. The location of most of Poland's public institutions in 16 cities provides the scope for concentration without – in most cases – the need for complex, managerially challenging multi-city universities. The large number of broadly specialised and highly specialised institutions also suggests a concentration strategy: a move towards a smaller set of more comprehensive universities. The concentration options must be explored in detail on a city-to-city basis and be guided by a number of important policy considerations, including consultation with local and regional authorities.

Table 4: Poland: population by region and major city, public (non-vocational) HEIs and graduates *(graduates per 1000 population is not an accurate measure of regional access to HE as it is affected by inter-regional mobility patterns)*

Region	Population (2015 estimates in millions)	% of Poland's population	Largest city (population in thousands)	Public HEIs in city (region)	2015 public HEI graduates	2015 graduates per 1000 population
Mazovia	5.3	13.8 %	Warsaw (1744k)	12 (14)	41k	7.7
Silesia	4.6	12.0 %	Katowice (300k)	6 (10)	27k	5.9
Greater Poland	3.5	9.1 %	Poznan (542k)	8 (8)	25k	7.1
Lesser Poland	3.4	8.9 %	Krakow (761k)	10 (10)	38k	11.2
Lower Silesia	2.9	7.6 %	Wroclaw (636k)	8 (8)	23k	7.9
Lodz	2.5	6.5 %	Lodz (701k)	6 (6)	15k	6.0
Pomerania	2.3	6.0 %	Gdansk (462k)	6 (8)	17k	7.4
Kuyavia-Pomerania	2.1	5.5 %	Bydgoszcz (356k)	3 (4)	12k	5.7
Lublin	2.1	5.5 %	Lublin (341k)	4 (4)	13k	6.2
Subcarpathia	2.1	5.5 %	Rzeszow (186k)	2 (2)	11k	5.2
West Pomerania	1.7	4.4 %	Szczecin (406k)	5 (6)	10k	5.9
Warmia-Masuria	1.4	3.6 %	Olsztyn (173k)	1 (1)	7k	5.0
Swietokrzyskie	1.3	3.4 %	Kielce (198k)	2 (2)	7k	5.4
Podlaskie	1.2	3.1 %	Bialystok (296k)	3 (3)	8k	6.7
Lubusz	1.0	2.6 %	Zielona Gora (139k)	1 (1)	3k	3.0
Opole	1.0	2.6 %	Opole (119k)	2 (2)	6k	6.0
Total	***38.4***	***100 %***		***79 (89)***	***263k***	***6.8***

Source: Jon File, 2015 HEI and graduate data and 2016 regional population data from Central Statistical Office of Poland (GUS) http://stat.gov.pl . 2016 estimated city populations from https://www.citypopulation.de/Poland-Cities.html
Note: Graduates per 1000 population is not an accurate measure of regional access to HE as it is affected by inter-regional mobility patterns

Mergers make sense if the institutions' strengths complement each other, making it easy to build critical mass and achieve synergies. It is worth noting that mergers and consolidations involve risks: the new, consolidated institution can be dysfunctional because of a clash of institutional cultures. The size of the merged institution is also an important factor to consider

Concentration might also have a bearing on the potential selection of flagship universities. The selection criteria for flagship universities as well as for excellence initiative universities could also impact concentration. Poland might decide that achieving an excellent critical mass, the dynamics of science, and the growing importance of inter-disciplinary research would be best served by having broader

comprehensive universities in these categories (rather than more specialised technical, medical or economics universities). This would be a powerful incentive for consolidation. However, there are many examples of top-ranked specialised universities (MIT, Caltech, Imperial, Karolinska, etc.) so this is a question of Poland's preferences for its flagship institutions.

The proposed universities of applied sciences will create their own concentration challenges. If there is significant vocational programme expertise in the higher vocational school sector (the panel has been unable to assess this) it might be possible to use this as seed capacity in merged institutions where the other constituent parts have traditionally delivered academic programmes. The higher vocational school sector is also the most dispersed geographically given the decision to locate such schools in previous regional capitals when, in 1999, the regions were reduced from 49 to 16. Multi-campus regional universities of applied sciences would be another option, but require careful design to overcome multi-locational challenges.

The question of whether the concentration process should be driven by legislation or financial incentives is complex and context-specific. System-wide concentration or merger processes are extremely complex, particularly in an HE system as large as Poland's. Developing a national blueprint or guidelines is a demanding task. South Africa reduced its apartheid legacy of 36 HEIs to 21 in 2002 by a Cabinet decision as to which institutions should merge. More recent European experience in Finland, Wales, Norway and Denmark favours government coordinated and financially supported voluntary mergers within a framework of clear and motivated goals for defining the future system. **The panel favours the latter voluntary and incentivised approach.** The availability of adequate 'merger support funding' will be a key policy tool in the consolidation process. (See the Learning Model 4.6.4 on HE mergers in Finland and Wales: targets, funding, time frame and autonomy.)

3.4 Public research institutes outside the university sector

Poland has a significant part of its public research, development and innovation capacity outside of the university sector. The 114 public research institutes employ more than 12 000 researchers while the 70 research institutes within the PAN are home to a further 8000 researchers. While the universities account for a large share of the highest achieving scientific units (62 % of the units evaluated as A+ with 73 % of those awarded an A), there are a significant number of strong performing research units in both the Academy of Sciences and the public research institutes (see *Table 5*).

A key strategic question for Poland and for other countries with significant public research capacity outside the university sector is whether the current organisational arrangement is appropriate given the growing influence of global university rankings. Would relocating strong research units into universities provide a better model given that one of the MNiSW's stated aims for reform is to raise the international visibility of Polish science and improve the performance of Polish universities in the global rankings?

In the panel's opinion, relocating strong research units into universities would be a better model because it will integrate Poland's strong scientific capacity in a single organisational model – research-intensive universities – which have the potential to become globally visible rather than the current situation where the capacity is spread across three sectors, two of which fall outside the scope of international university rankings[24].

Table 5: Research evaluation scores of Polish research units by sector, 2013

Region	A+	A	B	C	Total
Units of universities	23	225	451	57	756
Polish Academy of Sciences institutes	12	42	15	1	70
Research institutes	2	35	70	8	115
Others	0	6	5	11	22
Total	**37**	**308**	**541**	**77**	**963**

Source: Information supplied by Dominik Antonowicz of the Research Unit Evaluation Committee following the panel's interview with the committee in March 2017. For more information on the research evaluation see Chapter 4.4.
Note: The table shows results from 2013 (before appeals), therefore the number of units in the groups may have changed slightly since then. Notably, in the case of research institutes, appeals were important because the number of A+ units rose from 2 to 4.

The rationale for other countries such as Denmark, for example, when they have embarked on a similar process has been to make better use of existing resources, in particular experienced research staff and research infrastructure. By concentrating critical mass in fewer institutions and exposing students to some of the best research capacity, the overall quality of activities will increase and more units will become internationally competitive. Furthermore, when working as colleagues with the university faculty, the mission-guided national research lab staff may facilitate their integration within Poland's national innovation system and forge stronger collaboration between science and industry.

The following proposals concerning the future location of A+ and A units currently outside the university sector would involve a complex process requiring careful management. Large units cannot simply be incorporated into the most cognate university departments (a 300-researcher unit would have to be incorporated as an organisational unit). Furthermore, in many cases, incorporation will result in multi-campus universities since physical relocation would be prohibitively expensive and personally untenable for research staff.

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24 The single organisation model is an underlying reason for the stronger performance of top Swiss universities in the international rankings when compared to those in Germany which, like Poland, has significant public research capacity outside the university sector.

3.4.1 Reorganising the research institutes

To tackle the low performance and fragmentation of the 114 public research institutes, including the low commercialisation of research results, the MNiSW is planning to reorganise the sector. The first plan presented to the panel evolved in three directions: their incorporation into a Fraunhofer-style National Institute of Technology (NIT)[25]; their incorporation into universities; or their conversion into 'commercial' public companies[26]. The intention was that around 35 public research institutes, mainly under the jurisdiction of the ministry of development, would be brought within the new NIT.

As a result of the consultation, the MNiSW has abolished the NIT plan and is now envisaging a new framework 'Research Network Lukasiewicz', a network of autonomous entities coordinated around major projects, either based on the Strategy of Responsible Development or the initiative of groups of institutes. The main council of the research institutes supports the aims of the bill, preferring an umbrella body with competence centres within which the institutes would retain their independent legal status. While the challenges facing the research institutes justify the reorganisation and consolidation efforts (see Box 3.2), **the panel recommends that the government ensures that the new organisation's focus areas are selected as a result of a foresight exercise in view of the need to support the Polish economy and society** rather than simply regrouping (some of) the existing institutes in the new network structure. In this respect, the foresight exercise for the Strategy of Responsible Development, which identified field such as electromobility and medical robotics, provides a good starting point.

It is unclear how many of the A+ and A public research institutes are earmarked to form part of the new organisation, but as indicated above, **the panel's view is that the best option would be to consider on a case-by-case basis how to locate these 37 institutes within research-intensive universities.** In 2007, the Danish government launched a merger process which reduced the number of universities from 12 to eight and transferred 12 of the 15 government research institutes to the eight remaining universities. The result was a large concentration of resources in a limited number of institutions. The research institutes have significantly enriched graduate programmes at the universities and have further diversified their income streams. The key overriding principle, in line with European Commission recommendations, is not to separate research and education[27].

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[25] This organisation should carefully examine Fraunhofer Gesellschaft's intellectual property strategy which forms a key part of its success in knowledge exchange; see Learning Model 5.7.2 on Fraunhofer IP.

[26] According to government plans, the NIT aims to create synergies, avoid duplication of efforts and ensure more efficient management by harmonising the mechanisms of financial, human resources and estate management, as well as intellectual property rights. Competence centres in strategic areas will facilitate collaboration and interdicisplinary R&D.

[27] We could also point to the EC recommendations on not separating teaching and research https://ec.europa.eu/education/sites/education/files/he-com-2017-247_en.pdf

During the reorganisation and consolidation process, care should be taken to ensure that consolidation costs do not surpass its benefits and that the industry-facing nature of the units is strengthened. This implies making sure that the best-performing institutes do not risk losing their market position, clients and certifications. A solution should also be found to accommodate participation in external high-level committees by the representatives of relevant research institutes. The Lukasiewicz Network's current plans appear to satisfy these needs as they address some of the key processes and procedures (IPR and research infrastructure management), but not the clients or certificates. At the time of the review visits, concerns among the research institutes seem to focus on the process rather than the idea of consolidation.

Box 3.2: Challenges for the research institutes

The operation of 114 different research institutes, supervised by 16 ministers, has led to inefficiencies, fragmentation and dispersion of resources. Research institutes have not been able to realise economies of scale and acquire large-scale international projects. There are challenges and duplication of efforts in purchasing policy, intellectual property management, commercialisation and knowledge transfer.

- The fragmented supervision by 16 ministers undermines the possibility of implementing the innovation policy. Research institutes carry out their own research agendas, often driven by the individual interests of staff and the acquisition of grants, rather than national policy.

- Many research institutes are inactive in patenting. In the period 2009-2015, 32 research institutes (28 % of the total) did not obtain a single patent.

- The revenue stream from R&D services remains modest. In the period 2013-2015, only 7.3 % of research institute income came from sales of R&D services (12.5 % when excluding medical research institutes). Almost one-third of the research institutes (37) have higher income from rental property than from R&D sales.

- Research institutes lack competitiveness at the international level. In 2015, 35 out of 114 did not win any international grants, while nine were granted only small awards. Only 36 (31.6 %) won Horizon 2020 funding, including 22 which were involved in just one project. Only 55 researchers, less than 0.5 % of the total, come from abroad.

3.4.2 PAN research institutes

One of the issues discussed in the context of restructuring Poland's science and HE sectors is the idea of creating closer links between (research) universities and PAN's 70 research institutes with their integration into the universities as a future goal (see Kwiek et al. 2017). It is not clear why this proposal is only envisaged in Poland as a goal for the future.

For the strategic reasons outlined above, it would be better to locate the 54 PAN institutes with A+ and A evaluations – which represent a significant strong research resource - in research-intensive

universities. Their location at research-intensive universities should also be considered on a case-by-case basis. The remaining research institutes should be incorporated in the NIT (where appropriate) or in universities, thereby making the PAN a distinguished scientific society and not, in addition, a research-performing organisation separate from universities and the NIT.

In making this proposal, the panel has considered **the Academy's aspirations to establish a 'University of the Polish Academy of Sciences' (UPAS)** by adding didactic cross-institute cooperation by offering PhDs and a limited number of master's programmes to the Academy's current research mission of (primarily) basic research and PhD training in 70 independent institutes. The vision includes doubling the number of graduate degree candidates (from 2000 PhD candidates to 4000 PhD and master's candidates), the development of interdisciplinary graduate programmes to help break down the internal walls between institutes, and a significant investment (source unclear) in international PhD candidates, postdocs and professors. The Academy is currently responsible for some 14 % of Poland's scientific publications and believes that UPAS would give it visibility in the global university rankings (a chance to be placed around 200 depending on the ranking).

The argument for merging PAN institutes with the universities relates to the need to integrate Poland's strong scientific capacity in a single organisational model – research-intensive universities – rather than the current situation where capacity is spread across three sectors. One of the advantages of this integration would be that the scientific output and impact of the academy institutes and public research institutes incorporated would strengthen Polish research universities' performance, including in the global university rankings. The UPAS is an example of creative 'out of the box' thinking. However, the panel is not convinced by the financial or organisational viability of building a cohesive graduate university from 70 independent and geographically dispersed research institutes. In addition, the team favours the strategy of strengthening the leading group of Polish research universities rather than creating a new and atypical university that would be more in competition with them than the PAN is at present (doubling PhDs, limited number of master's programmes).

3.5 Recommendations on higher education and science landscape reform

To unleash the full potential of Poland's HE sector, the PSF panel proposes that Law 2.0 should provide a broad framework for autonomous HEIs rather than a detailed and complex set of regulations that are currently restricting the system. The panel supports the strengthening and concentration of Polish research capacity and developing a more relevant higher quality education.

While several possibilities exist and the panel understands the logic behind the early trinary system plans, it favours a binary HE system comprising university institutions and universities of applied sciences, with the former including around 10 research-intensive universities selected for a Polish excellence initiative involving additional multi-year funding. After the initial funding period, three (for instance) flagship universities would be established with substantial additional funding. The combination of an excellence initiative and the establishment of a UAS sector would constitute a lighter policy tool that is more flexible and easier to adapt to changing circumstances than the legislative enactment of a trinary system. Ideally, all institutions should see benefits for themselves in the major system reform, which will require the very careful allocation of new funding to be injected into the system. The panel further proposes the relocation of strong research units into universities, which would integrate Poland's strong scientific capacity in a single organisational model – research-intensive universities – rather than the current situation whereby capacity is spread across three sectors.

Create a more diversified HEI landscape

- **Develop a robust binary system of HE by establishing a modern university of applied sciences sector that should enrol a significant proportion of HE students within a decade (around 20 %).** Classifying institutions as teaching institutions will not in itself create a clear and positive vision for vocational HE nor a wide range of vibrant career-focused programmes well-connected to labour market needs and embracing modern creative approaches to teaching and learning. The panel's view is that the creation of a modern UAS sector in Poland is the structural reform needed to achieve these objectives. Poland does not need teaching colleges offering traditional academic bachelor degrees to create an effective mass HE system.

- **Carefully investigate the development trajectories and cost-sharing models of dual universities in different socio-economic contexts, such as the leading Dual University DHBW, and particularly the DHGE in Thüringen in eastern Germany.** The key points for Poland are the long development trajectory of dual institutions, the replication of study fields (business, engineering and social studies) in institutions, close contacts with the local industry which sends the student to the dual university, and the funding model where the costs of the study programmes are covered by the respective state, while the business partner pays the monthly grant to the student-employee. Poland should ensure cost sharing in the funding for internships and job placements from two sources: the state and employers.

- **Strengthen and concentrate Polish research by introducing a Polish variant of a competitive excellence initiative in selected research-intensive universities (around 10).** This would be a competitive process through which a set of research-intensive universities are awarded significant additional multi-year funding to boost their research capacity and performance. A good example of such is the German Excellence Initiative. The panel believes that the best method of selecting excellence initiative universities is a high-level international peer-review-based selection process. The attraction of an excellence initiative is that it does not require splitting Poland's universities into research universities and research and teaching universities. They would all remain universities and retain a significant teaching function while operating at different levels of research intensity.

- **If the government decides to select flagships, towards the end of the first excellence funding cycle it should select the best-performing universities (around three) as flagship universities with significant additional multi-year funding.** Given that the goal is research excellence and concentration, the flagship universities are a strategic option. Their selection should be a competitive process launched towards the end of the first period of new multi-year competitive funding for those universities selected for the excellence initiative (around 10 universities). In other words, the panel envisages a two-stage competitive process: first, selection for the excellence initiative; and second, towards the end of the first funding period, selection from within this group of universities for flagship status. The selection should be based on research performance and impact, including the results achieved through the new funding. The selection of flagship universities should also be made by international peer review. Competition for flagship status should be reopened in each new funding period rather than awarding flagship status 'for life'. Delaying the selection of flagship universities also allows for a period of potential institutional reconfiguration in terms of the consolidation processes which could influence the selection of flagship universities.

- **Consider a reduced or capped role for flagship universities in first-cycle education.** The awarding of flagship status is likely to have a significant impact on institutional reputation. Many potential students will probably be attracted by this reputation and seems likely that flagship universities will recruit the most talented bachelor students. To mitigate the impact on other universities, the MNiSW should consider a reduced or capped role for flagship universities in first-cycle education – in other words, limits on the number (or proportion) of bachelor and equivalent students they can enrol. This would also allow the flagship universities to concentrate more on their core business: excellent research, PhD education and research master's programmes.

- **Support and maintain this diversified HE system through mission-differentiated governance, funding, human resource management, and institutional evaluation and programme accreditation criteria.** To ensure that all institutions see the benefits of HE reform, provide new resources for excellent research, for applied research and development, for developing innovative teaching and learning approaches and for stimulating the role of HE in regional development. This diversity in funding is essential if institutions are to diversify their missions.

Reduce the number of public HEIs through consolidation

- **An MNiSW-coordinated consolidation process should be initiated based on voluntary mergers which are supported financially within a framework of clear and motivated goals for the future system.** The question of whether the consolidation process should be driven by legislation or financial incentives is complex and context-specific. System-wide concentration or merger processes are extremely complex, particularly in an HE system as large as Poland's. Developing a national blueprint or guidelines is demanding. The panel favours a voluntary and incentivised approach. The availability of adequate 'merger support funding' will be a key policy tool in the consolidation process.

- **The primary consolidation target should be those large cities which are home to 79 public HEIs.** The consolidation strategy should be to move from a large number of broadly specialised and highly specialised institutions to a smaller set of more comprehensive universities. While a large number of small institutions does not create the most efficient environment, international experience suggests that the financial advantages of merger operations, if any, are likely to be realised only in the longer term. Mergers have the potential to create stronger more sustainable institutions and a more 'steerable' system. The future consolidation strategy should take advantage of the proximity factor with decisions made on a case-by-case basis. Options must be explored in detail on a city-by-city basis and must be guided by a number of important policy considerations, including consultation with local and regional authorities.

- **To ensure sustainable regional provision of HE, conduct an assessment of current and planned capacity against anticipated student numbers and identify gaps in staff and infrastructure.** As an intermediate step, strengthen flexible multi-provider learning and extension centres with support for industry development. Support should be provided for centres that draw on a range of providers, including both universities and higher vocational schools, to ensure the broadest possible choice and the most sustainable future. When developing or rationalising the network of education providers, care should be taken to ensure that the region will have access to lifelong learning services and business-related services. Coordinated negotiation and planning processes should be government-led with the regions.

Incorporate the best-performing research institutes and PAN units into research-intensive universities, and ensure that doctoral degree awarding powers are invested in universities

- **The A+ and A evaluated public research institutes should be incorporated into research-intensive universities. The mode of incorporation and the most suitable host university should be considered on a case-by-case basis and care taken to ensure that the close industry connections continue to be enhanced.**

- **The A+ and A evaluated PAN research institutes should also be incorporated into research-intensive universities. The mode of incorporation and the most suitable host university should be considered on a case-by-case basis.** The argument for merging these institutes with the universities responds to the need to integrate Poland's strong scientific capacity in a single organisational model – research-intensive universities – rather than the current situation whereby the capacity is spread across three sectors. One advantage of this integration would be that the scientific output and impact of the PAN and public research institutes incorporated would strengthen the research performance of Polish research universities, including in the global university rankings. The remaining Academy research institutes should also be incorporated into universities, thus making the PAN a distinguished scientific society rather than a research-performing organisation separate from universities.

- **Ensure that doctoral degree-awarding powers are invested in universities.**

3.6 Learning models

3.6.1 Universities of Applied Science in the Netherlands

The Dutch HE system is a binary structure; it comprises 14 public universities and 37 universities of applied sciences. The two subsectors have different mandates, different histories, and are different in size.

The historical roots of the current UAS institutions extends over many decades, but as a part of tertiary education their history dates to the 1960s, when colleges for higher professional education were upgraded. In 1986, they were legally acknowledged as an HE subsector. Their main task is to offer theoretical and practical training with an explicit professional orientation. Since 2001, transferring and developing knowledge has been a second important task. Their primary focus has traditionally been on regional and local needs, although several UAS also operate nationally and internationally. The UAS sector hosts institutions varying in size and orientation, from small mono-disciplinary institutions to large multi-disciplinary ones. Around two-thirds of Dutch HE students are enrolled in UAS institutions.

The recent history of the sector is characterised by: (i) considerable growth in student numbers, from 181 100 in 1975 to more than 446 000 in 2016; (ii) a reduction in the number of institutions: from 375 in 1983 to 37 in 2015; and (iii) increased maturity as a well-recognised, valuable and full part of the HE sector, as indicated by enhanced institutional autonomy.

Source: Harry de Boer, CHEPS

3.6.2 Dual universities in Germany: DHBW and DHGE

Germany has a well-developed tertiary education sector including research-intensive universities, universities of applied sciences (Fachhochschule) and 39 dual universities (Dual Hochschule). Dual universities are now present in half of the German states. The best established example is Dual Hochschule Baden-Wurttemberg (DHBW) which is located in Baden-Wurttemberg. This is Germany's economic engine with a highly developed industry structure and higher than average GDP per capita. However, successful dual universities have also been established in eastern Germany to address much more difficult economic conditions and a mainly SME-based economy. One of these is Dual Hochschule Gera-Eisenach (DHGE) in the Federal State of Thuringia which could serve as an inspiration to the Polish authorities.

DHBW has grown in less than 20 years from a Berufsakademie into the biggest HEI in Baden-Wurttemberg. It has 35 000 students across campuses in different parts of the state pursuing dual-study programmes in business, engineering and social studies. The three-year study programmes are divided into three-month periods alternating intensive learning at the DHBW and working at a company (or public sector). DHBW has over 9000 industry partners that take part in the design and delivery of study programmes and cooperative applied R&D in carefully selected industry-relevant topics. All students are employed by the partner firms (before they apply to DHBW). The industry partner pays the student a monthly grant, and they are also eligible to receive public means-tested student aid. DHBW's results are spectacular: it has low dropout rates, high graduate employment immediately on completing a degree, and its graduates have better prospects for career progress than graduates of other HEIs. DHBW attracts the highest achieving graduates from upper secondary schools, not only from Baden-Wurttemberg, but also across Germany. It is a model well-managed multi-campus HEI with an international orientation. It uses modern business and management mechanisms, and has designated key account managers for industry partners, for example, and shares its expertise and experience across Europe and beyond.

DHGE was founded in 1998 as Staatliche Studienakademie Thüringen with Berufsakademie Eisenach and Gera following the concept of Berufsakademie Baden-Wurttemberg. DHGE has only 1250 students on the two campuses in the cities of Gera and Eisenach. It attracts motivated graduates from upper-secondary schools, not only from Thuringia but across Germany. Students pursue dual-study programmes in business, engineering and social studies, alternating withperiods in industry. Dropout rates are low at 15 % and employment rates higher. DHGE bachelors can continue their studies under the special DHGE part-time master programme, or via master's programmes at a regular or applied science university. DHGE has over 1800 industry partners, mainly SMEs. Close contacts are kept with the partner firms by both professors and DHGE programme managers. Each programme manager is in regular contact with respective partners to ensure that the employer knows what is going on at the DHGE and that the programme manager understands the difficulties of everyday business in the partner firms. Unlike big companies, many SMEs cannot send new students to DHGE every year but typically do this every few years. Company visits and personal discussions with company representatives help convince the partner firms that their future specialist requirements can be secured with the help of DHGE dual education. The State of Thüringen provides the theoretical studies through DHGE and the partner companies provide practical training and pay students monthly grants.

The DHGE experience shows that major cities with large universities do not provide the best environment for dual universities. In smaller cities, dual universities benefit from more limited competition in the distribution of state funding and access to companies which are 'hidden champions', depending on specialist skilled workers. Key to establishing and running a successful dual university is close collaboration with local and regional business and industry associations which can help convince their members of the long-term benefits of dual study.

Sources: Raimund Hudak, DHBW and Stephan Rometsch DHGE

3.6.3 German Excellence Initiative

Germany is unusual among most Western countries in that all of its universities have been designed to be roughly equal in both quality and prestige. While levelling the playing field for students, who mostly choose schools closest to home, the strategy has prevented Germany from producing world-class institutions that can effectively compete with those in other countries.

Launched in 2004 to solve that problem, the Excellence Initiative attracted applications from 74 of the country's 120 publicly funded universities, all aiming to share the EUR 1.9 billion state and federal governments had set aside to boost competition in the coming five years. In the end, 22 universities received extra funding, either for new graduate school programmes (EUR 1 million a year each) or for excellence clusters (worth EUR 6.5 million a year) designed to bring together top researchers from several disciplines. The most prestigious funding awards, however, went to the Technical University Karlsruhe[28], the Technical University Munich and the Ludwig-Maximilians-University Munich, which each received about EUR 13 million extra annually for their university-wide plans to boost research excellence. More important than money was the reputational value that the award bestowed in the competition on top professors and other external funding.

Source: Gretchen Vogel (2016), A German Ivy League Takes Shape, Oct. 13, 2006 www.sciencemag.org

3.6.4 Higher education mergers in Finland and Wales: targets, funding, time frame and autonomy

Mergers in Finland and Wales were intended to make the HE system more competitive, to improve performance by concentrating resources in fewer, stronger institutions (achieving critical mass, economies of scale and efficiency), while maintaining a regional spread of HE provision to serve the population. Competition for Finland meant being stronger in global competition, while in Wales competition was with the rest of the UK.

In both cases, the structure of the policy process was fairly similar: the central authority proclaimed the goals and the main reform method. The central authority named a target number of HEIs to which it wanted to reduce the system: from 20 to 15 in Finland, and from 13 to around 6 in Wales. (In Wales, the numerical target was not very strict, and having reached eight institutions and realising there were no more volunteers for merging, the regional government and funding council were satisfied.) In Finland, the target number was attained well before the target year of 2020.

The main policy instruments were largely similar in both systems, with a central role for project funding: HEIs which engaged in (the first steps of) a merger process could gain additional financial support from the central authority. A time frame was established in both systems: bids for project funding had to be submitted before a certain date and a (fairly loose) end date was also set.

Through negotiations and close monitoring of the merger project organisations (groups including leadership from the HEIs were involved) the central authority (ministry of education and culture in Finland; Higher Education Funding Council for Wales) kept a close watch on the desired direction of the merger processes and their progress. In Finland, monitoring of performance agreements also took place through negotiations.

In both cases, institutional autonomy was respected. The HEIs that entered into a merger process did so on the basis of a voluntary strategic decision on their part. In Finland, less far-reaching options for cooperation were also proposed,

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[28] Karlsruhe later lost the excellence status on the basis of international evaluation.

such as associations, to make the process less daunting at first, and to provide an exit route which institutions could take with grace rather than having to acknowledge failure if a full-scale merger was not attained. Also, in both systems individual arrangements could reflect different interpretations of the meaning of merger. In Wales, this was explicit; each merger was treated as a *sui generis* case. In Finland, the three mergers revealed different levels of integration, for example with the two merged institutions in Turku retaining their own strategies.

Source: File et al. (2016) Structural Higher Education Reform - Design and Evaluation: Synthesis Report European Commission (DG EAC), April 2016 (pages 35-37)

4 KEY FRAMEWORK CONDITIONS

4.1 Governance of public higher education institutions

Governance systems in many mature HE systems are transitioning towards more managerial models, and greater institutional autonomy combined with accountability. The international trend is to enhance institutional autonomy by reducing direct state control with less involvement in the running of HEIs on a day-to-day basis, combined with new forms of supervision and influence through accountability mechanisms. This implies: (i) strengthening the power of executive management within institutions, appointed leadership and management; (ii) reduced power and influence for collegial bodies; and (iii) governing bodies with external stakeholders (see, for example, OECD 2008). Many European countries have moved towards institutional autonomy to grant HE institutions – particularly universities – an independent legal status. Box 4.1. highlights the key aspects of the state of university autonomy in Poland.

Box 4.1: The state of university autonomy in Poland

Organisational autonomy: Universities appoint their executive heads independently; however, selection criteria, term of office and dismissal procedure are stated in law. The university senate may not include external members. Universities may determine their internal academic structures. The activities of any legal entities established by universities must be linked to the university's mission.

Financial autonomy: Universities are free to allocate internally the funds received through the annual block grant, but they do not control research funding which is directly allocated to faculties. The use of any surplus generated is subject to constraints imposed by the state. Borrowing is possible with some restrictions. Property transactions require external authorisation depending on the origins of the buildings involved. Universities may not charge full-time national or EU students tuition fees. Fees for non-EU students are set via cooperation between universities and an external authority.

Academic autonomy: Universities decide on student numbers and set admission criteria at all levels. They may introduce new bachelor's and master's programmes but there are some restrictions on their ability to introduce new doctoral degree programmes. Polish universities cannot choose quality assurance mechanisms (mandatory programme or faculty-level accreditation) and providers.

Staffing autonomy: Universities recruit senior administrative staff freely, but there are legal restrictions to recruiting senior academic staff. Minimum salary levels are set by an external authority. Dismissals of senior academic staff are subject to regulations specific to the sector, while this does not apply to senior administrative staff. Senior academic staff have a special status in law with rights that provide them with a high level of protection against dismissal.

Source: EUA, http://www.university-autonomy.eu/countries/poland/

At the same time**, a key issue in university governance is to ensure the sense of ownership by the university community, while implementing any structural changes that are required from time to time** (see Boulton and Lucas 2008). In a White Paper presented to the Swedish government, Bremer (2015) notes: "Collegiality is a fundamental component of the management of universities" complementary to line management (Rector, deans, heads of department, etc.). The roles of academic collegial management and line management in HE systems should be clarified and strengthened.

Autonomy in internal organisation and funding is important for research performance. In their internal organisation, universities increasingly need a combination of solid departmental structures which are aligned with the teaching needs and a more flexible research organisation in which temporary, sometimes interdisciplinary centres are organised around outstanding research leaders, larger infrastructure and external funding opportunities, combined with funding for multiple individual projects. A thriving undergrowth of smaller and individual, sometimes interdisciplinary projects provide the basis for the dynamic development of research centres and, in the long term, potential for new departments, study programmes, etc.

Successful institutions have found ways to differentiate internal academic freedom to enable the most outstanding researchers to pursue their research interests. Institutions and the collegial academic governance structures must provide opportunities for individuals to experiment with their talent. This means that within large institutions the leadership must differentiate the 'freedom space'. This could be interpreted as unequal distribution of opportunity, but when the legitimate academic peer forces are properly brought into play it is a fair and equitable system. It is important institutions do not accept an even distribution of resources but carefully direct resources to creativity centres where individual researchers can benefit from a higher level of autonomy.

4.1.1 Autonomy, governance and management in public higher education institutions in Poland

In Poland, the potential of HE and research is hampered by the public universities' sub-optimal governance system, due in part to the remaining legal constraints and heavy administration, and also to the inertia of HEIs.

- **Public HEIs – with the exception of public higher vocational schools (PWSZ) – have strong academic self-governance with a lack of direct involvement by stakeholders outside academia.** External participation in the governance of public universities is not permitted by law[29]. The lack of external influence in governance is one of the key aspects driving inward-looking institutions with a focus on supply-driven education and R&D.

- **Rectors have formal responsibility for their universities, but their ability to exercise effective leadership is limited.** The 2010 HE reform enabled HEIs to select rectors through open competitions, although none of

[29] In contrast, the Law on Higher Education (Article 63) mandates private HEIs to have an advisory body called "convention" with at least 50 % of members representing the socio-economic environment and local government.

the public universities have used this option. Rectors and the heads of academic units are selected from faculty members by electoral colleges. The senate, with elected staff and students, decides on all important matters. See Box 4.2. for the panel's ideas on the potential roles and selection of top management in universities.

- **Individual faculties and departments are relatively autonomous in relation to the university centre.** This decentralisation of powers could in principle incentivise RDI and entrepreneurial activities at the individual and faculty level. However, in practice it is reducing institutional capacity in strategic decision-making, and the prioritisation and resourcing of central and horizontal activities. It also constrains the development of financial headroom for strategic openings (new interdisciplinary programmes, strengthening important centralised services, etc.). In short, it is reducing the Polish universities' ability to pursue and implement university-wide reforms.

- **Internal budget allocation could be a tool for developing and driving institutional development.** Interviews showed that there is limited freedom to make use of any surplus generated. Public universities cannot control the distribution of research funding which is directly allocated to scientific units, but they can freely distribute the annual block grant (see Chapter 4.2). However, in order to avoid institutional inertia, most public universities approach budgeting as a technical exercise, either by mimicking the national funding allocation system or passing on state funds to the faculties, with minor modifications. This leaves very limited resources available for a university to make strategic choices. The general impression is that public institutions do not use strategic institutional funding allocation models which typically combine: (i) base funding, which builds on size (FTEs, number of student, etc.); (ii) performance-based funding; and (iii) strategic funding for special purposes and prioritised investment. See the Learning Model 4.2.7.4. on institutional funding allocation models in five universities (Chapter 4.2), which highlights a range internal budget distribution models and could serve as an inspiration to Polish HEIs.)

- **A prerequisite to the effective use of competitive funding – whether national or international (EU) funding programmes – is a sufficient level of core funding available for the institutions. Furthermore, setting the overhead rates at a low level will limit an institution's ability to support the development of quality central services and the implementation of university-wide strategies** because a *de facto* institutional co-contribution is necessary (often in kind, such as square metres, staff time, etc.). Ultimately, this can lead to a large number of self-standing units each pursuing their own interests rather than the university's interests in general. It can create situations in which the university will have to back-stop from its core resources to satisfy external contractual requirements. Furthermore, there are risks related to financial management and reputation due to both national and EU legislation[30].

[30] For example, equality and diversity issues, international accountancy standards. etc.

Polish HEIs also need to deal with over-regulation, which is common in many HE systems, usually arising from increasing expectations on HE. In Poland, over-regulation is partly linked to the 20 or more funding streams coming from the MNiSW which generate a significant burden on HEIs and may reduce their interest and ability to pursue excellent research and teaching, as well as contributions to innovation and regionally and locally relevant activities.

Box 4.2: The PSF panel's recommendations on potential roles and selection of the rector, senior management team and senior deans in universities

The rector is the university's external face and top-line manager (CEO), responsible for the day-to-day management and leadership as well as appointing academic leaders and managers at other levels[31].

Selection of the appointed rector could be done by the university board. In this case, the board advertises an open call (in Poland and/or internationally) for candidates for the rector position. Candidates should be accomplished academics (proficient in Polish and conversant with Poland's HE and research system, but with an international profile). The board could establish a separate search committee which includes participation from the university's board, academic councils and top management. Following an appropriate search process, the committee would present its recommendation to the board, which in turn would select the best candidate for the position.

The rector must be supported by a senior management team of five to seven members, who would meet weekly. The rector would delegate responsibilities for general academic affairs (study and research matters) to one or two vice(pro)-rectors (similar to provosts in North America), and administrative affairs to a general manager. The internal academic affairs could be delegated to senior deans for the main academic areas in multi-faculty institutions if a consolidation of faculties is not possible. (Four to five main academic areas could be humanities, social sciences, medical or health sciences, natural and technical sciences.) The senior management team would share all information and be on the same 'side of the table', working for the best of the entire institution, while bringing to the table insights from each member's area of responsibility, whereas regular deans and heads of departments, etc. would focus on their unit. Budget, financial matters, investment, QA, human resource policies, including all aspects of HR management, would be developed by the rector and senior management team, and established by the university board.

The senior deans (for main areas) would be responsible for developing a human resource strategy and budget for their area within the university's policy and for faculty recruitment for his/her area. For many faculties – often with overlapping mandates (for example, molecular biology, biotechnology, biomedicine or law, corporate law, public sector management), the senior dean would be

[31] The principle is that the manager first in line selects the candidate for a position and the second in line oversees the process. For example, the dean could select heads of department and the rector could appoint them. Academic councils would have no formal role in this process. Open leadership positions could be advertised widely, in national and, where appropriate, international media.

responsible for cross-cutting coordination. Within each faculty, the dean would be assisted by the head of unit (department, institute or research centre), and would consult with the academic council.

4.1.2 Recommendations on the governance of public HEIs

The governance system of Poland's HEIs could be transformed from a traditional collegial academic system towards a more managerial one which would match the needs of the more complex reality of modern institutions. This would entail consolidation of university autonomy while at the same time ensuring accountability, and would increase the 'arm's length' to the government. Institutions should be free to decide on their own internal organisation. The government could consider a staged process for achieving greater autonomy for some institutions: an agreement could be reached whereby a group of universities could apply to adopt more managerial forms of governance and be granted a higher degree of autonomy. Such a programme could run for five to seven years as a pilot project that would be evaluated and results disseminated afterwards across the university system.

To ensure more effective, agile and accountable HEIs, the panel suggests the following measures:

- **Facilitate the development of sufficient, professional and executive leadership in HEIs in line with their profile.** Modern complex institutions cannot be governed effectively and exploit the benefit of autonomy without leadership which can also satisfy external demands for accountability. For universities, this implies strengthening institutional autonomy and balancing it with accountability. The Learning Model on Reforming university governance in Denmark is an example of how university governance can be reformed.

- **Allow institutions to organise a well-balanced governance structure in which the leadership is conducted with checks and balances both externally (society, funders, etc.), and internally (faculty, staff and students)** in line with their profile. Mandate external stakeholder participation in all HEIs reflecting their mission and profile.

- **In universities, ensure the new governance system seeks to balance the needs for more powerful and professional institutional management, the legitimate need for collegial influence, especially on academic matters, and closer links to key stakeholders and the market.** This may be achieved by supporting the appointed rector via a small and effective senior management team, consolidating faculties into a smaller number and supporting deans by 'small' academic councils. Collegial influence would therefore be concentrated at the faculty (and departmental) level, rather than the institutional level. See Box 4.2. above on the potential roles and selection of the rector, senior management team and senior deans. For universities of applied sciences, refer to the Finnish and Dutch examples.

- **Introduce a university board with (a majority of) external board members reflecting the type and mission of the institution.** Such a body/board of representatives would select and appoint the rector, decide on the institutional strategy based on a proposal presented by the rector, determine the budget and sign the statement of accounts. The board must have regular insight into the university's general matters and strategy and operate as a sounding board for the rector and senior management team in order to increase transparency and trust between the Polish society at large and the university community. The board should be relatively small (for example, 11 members). External members would be outstanding individuals conversant with the interests of the specific institution and society at large, and would be selected through a separate process by the board itself. Internal board members would be elected by faculty, staff and students, respectively (see also Table 3 in Chapter 3).

Reduce regulatory burden

- **Continue to investigate and reduce the extent of the regulatory burden of HEIs to save time and money**. Evaluate the potential costs of accountability related to the new governance systems in order to identify and quantify the main sources and extent of burden as well as seeking potential to improve by data sharing and a risk-based approach to quality assurance.

4.1.3 Learning model

4.1.3.1 **Reforming university governance in Denmark**

In Denmark, in 2003, a new University Act changed the governance system from a traditional collegial academic system towards a more managerial one commensurate with the much more complex reality of modern institutions. It focused on establishing university autonomy while at the same time ensuring accountability. The universities were converted to self-governing institutions in the public sector.

Currently, Danish universities are governed by a board with a majority of external board members. These members are outstanding individuals conversant with the interests of the university and society at large, and selected through a separate process by the board itself. Internal board members are elected by faculty, staff and students, respectively. The board selects and appoints the rector. The board advertises an open call for candidates for rector who must be accomplished academics. The board establishes a separate search committee with representatives from the board, academic councils and the university's top management. Following a proper search procedure, the committee presents its recommendation to the board.

The appointed rector is the university's external face and top line manager (CEO), responsible for the day-to-day management and leadership of the university as well as for the appointment of academic leaders and managers at other levels. The principle is that the first in line manager selects the candidate for a position and the second in line manager oversees the process. For example, the dean selects the heads of departments and the rector appoints them. Academic councils have no formal role in this process. Open leadership positions are always advertised widely often in national and sometimes in international media.

The deans are responsible for developing a human resource strategy within the university's policy and for recruitment of the faculty members. The dean are assisted by the head of unit (department, institute or centre), and will consult with the academic council. Human resource policies, including all aspects of HR management, are developed by the rector and senior management and established by the university board. In Denmark, institutions are completely free to decide on their own internal organisation.

The Danish university governance reform resulted in additional degrees of autonomy and the adoption of a professional governance model intended to enhance decision-making capacity and develop distinct institutional profiles. This reform was deemed a prerequisite for the government and parliament to entrust institutions to manage increasing autonomy, much larger budgets, and increasing enrolments.

4.2 Funding

Funding is the most influential policy tool any government can use to steer the behaviour of institutions and staff in the HE and science system. The key questions are whether the funding for HE and science system is sufficient, efficient and sustainable, given that EU funding will be phased out. Public investment in HE and R&I need to align with the necessary reforms to increase the efficiency and quality of these investments and the performance of the HE and science actors. Any additional funding should be linked to the reform of the regulatory framework, system consolidation, HE governance system, careers and mobility, quality assurance and evaluation and third mission and linkages with the business and society.

The following analysis will examine current funding allocation mechanisms (formula-based funding, competitive funding) and suggest improvements in terms of cost sharing.

4.2.1 Current spending and potential waste of resources

As noted in Chapter 1, **Poland's expenditure on HE as a ratio of GDP is only slightly below the EU-22 and OECD averages**. However, given the relatively low level of Poland's GDP per capita and the high number of students, the annual expenditure per student is dismally low. Furthermore, higher education R&D expenditure (HERD) is still less than half of the OECD and EU average (OECD 2016c). In 2014, Poland's HERD as a percentage of GDP was 0.27 % (up from 0.18 % in 2005), behind the OECD and EU-28 averages (0.43 % and 0.46 %, respectively) (OECD 2016d) (see Chapter 1).

The MNiSW is committed to increasing HE and science funding steadily over time and injecting substantial European Structural and Investment Funds (ESIF) into the reform of the HE and science system. From 2014 to 2017, Poland's public funding allocation grew from PLN 21.2 billion to PLN 24.4 billion, comprising PLN 8.4 billion for science (0.43 % of GDP) and PLN 16 billion for higher education (0.84 % of GDP). A significant part of this funding is from the EU: for 2017, the proportion of the EU funding allocated was 16 %, down from 28 % in 2014.

Table 6: HE and science funding in Poland, 2014-2017

Year	Budget for science (PLN billion)	Budget for HE PLN billion)
2014	7.1	14.1
2015	7.8	15.0
2016	8.3	15.8
2017	8.4* (0.4 % GDP)	16.0 (0.84 % GDP)

Source: MNiSW data based on budget acts
Note: *This figure includes PLN 7.4 billion from the MNiSW and PLN 1 billion from other ministries, mainly the defence ministry (PLN 700 million)

While the low level of public funding for research and HERD may be part of the reason for the underperformance of the Polish HE and science system, other causes relate to the inefficiencies in funding allocation and spending. These lead to a potential waste of public resources and relate to at least two aspects:

- **Fragmentation of the HE system into many small institutions leads to over-investment in the infrastructure (labs, buildings) and staffing costs** in overlapping operations and programmes. The HE sector's operational costs are high while performance and outputs remain at a suboptimal level. Due to the fragmentation, core funding is spread thinly across institutions, which constrains the development of critical mass[32].

- **Fragmentation of the funding allocation system by the MNiSW which leads to over-regulation and inefficiencies in HEIs.** The MNiSW is currently in charge of 20 funding streams which are allocated by means of entitlement budgets, formulae, application and competition. HEIs must report how they use the public funds and with what results, which adds to the burden of over-regulation and inefficiencies in institutions.

The government has recognised these shortcomings and is planning a major reform to consolidate the HE sector, by mobilising EU funding and simplifying funding allocation. The current plans are aimed at the major consolidation of the HE sector into different types of institutions (see Chapter 4). According to the plans presented to the panel by the MNiSW in March 2017, a non-competitive funding support of EUR 115 million will support the HE system consolidation and will be allocated for the planning, implementation and costs of restructuring the jobs. EUR 230 million will be

[32] International experience shows that a fully effective HEI needs a critical mass of at least some thousands of students.

injected into the system on a competitive basis to launch three development paths for HEIs: (i) universities with over 20 000 students (EUR 57.5 million – one-quarter of the total funding); (ii) universities with up to 20 000 students (EUR 57.5 million – one-quarter); and (iii) HEIs with at least 200 students (EUR 115 million – half). The ministry is also committed to simplifying the funding for HE and research by developing a single integrated formula for statutory research and education funding for universities, and reducing the number of funding streams while giving universities greater financial autonomy. See Chapter 3 for the panel's evaluation of the HE landscape reform.

A key task for the government is to introduce an investment target for efforts in HE and the science and innovation system and ensure the predictability of funding. Poland's HE, science and innovation system is currently operating on one-year budgets and would benefit from greater predictability. This could be achieved by three- to four-year rolling budgets of formula-based block grants for core funding, rewarding quality and impact over quantity and combined with competitive granting schemes and possibly performance-based funding with ambitious strategic plans. The competitive granting scheme should incentivise institutional transformation and restructuring the landscape, as described in Chapter 3. To protect the universities' resource base, part of the strategy should be committed to developing a robust non-university HE sector in the form of UAS as well as distance education and blended learning models.

The following sections analyse the current features of HE funding allocation. Funding for teaching activities in HEIs is currently allocated on an annual basis as block funding based on a combination of an historic base and formula funding. Separate formulae are used for universities and vocational HEIs. Currently, research units also benefit from the formula-funding based on the assessment of research quality. The aim is to develop an integrated funding formula for universities for both teaching and research activities with different weights for different types of institutions. In addition, the government makes use of competitive funding schemes.

4.2.2 Resource allocation through a funding formula

4.2.2.1 Resource allocation for higher education teaching activity

Distinct funding formulae for academic and vocational HEIs were launched in 2017 with an historic funding base of 50 % for each. The remaining 50 % is calculated on the basis of a formula[33] with four components for academic HEIs (students, staff, research, internationalisation) and three for the higher vocational schools (students, staff, income). While it is too early to evaluate the impact of the funding model on performance, it seems to be a move in the right direction: the formula has reduced the proportion of historic funding allocation, acknowledges the difference between the academic and vocational sectors, and allows for some predictability to the funding by limiting the annual change in the core funding. However, HEIs will still receive their funding on an annual basis which narrows down their scope for strategic planning and capacity for entering into international partnerships, for example.

[33] In 2017, these shares were 54 % and 43 %, respectively.

According to the MNiSW, the new system also incentivises consolidation by offering financial stability for five years (the new HEI can also spend money in excess of the cost of the merger), but due to the limited information available the panel is unable to evaluate this aspect.

The formula for resource allocation for teaching activity in universities (see Figure 19) **comprises a complex set of metrics based on points earned for a variety of activities** covering students (40 %), teachers (45 %), scientific research (10 %) and international cooperation (5 %), including the quality assessment based on the overall research quality score. The parameters used are themselves calculated as weighted sums of different categories of students, staff, etc. The formula seems well suited for accounting purposes and as a distribution mechanism for allocating basic funding for HE teaching within the state budget, although less conducive for steering institutions. This is because the link between the change in behaviour and the resulting change in funding is not clear. **The formula may also entail regressive elements, valuing quantity over quality, and may encourage the collection of points rather than excellent performance**:

- **The formula is based on input-oriented indicators which could be better balanced with output indicators**. The system counts different student and staff categories (weight 40 % and 45 %) which are corrected either by the 'teaching availability factor' (student-staff ratio) or 'scientific potential factor'[34]. In many HE systems, the number of students is balanced with output indicators that enhance institutions' efficiency and productivity (such as degrees, credits completed, employment rates, etc.).

- **The formula may expand doctoral training due to the extra bonus for the number of PhD candidates**, contributing to the risk of low-quality PhD programmes. Better results could be achieved by funding high-quality university doctoral programmes through competitive grants from the National Science Centre, as the German Research Foundation (Deutsche Forschungsgemeinschaft DFG) does. Separation of the responsibility for doctoral programmes and funding individual PhD students could enhance the production of high-quality PhD graduates (rather than incentivise HEIs to enrol a large number of PhD candidates). The number of PhD candidates could also be balanced with the number of PhD degrees completed, their employment rates, etc.

- **For scientific research (modest weight of 10 %), the formula counts the number of different types of research grants**, which allows for playing the system by splitting the projects.

- **With the inclusion of the 'teaching availability factor' (student-teach ratio) the MNiSW aims to focus more on the quality of education provided.** Although this is commendable it is not clear whether the current measure is suitable to enhance quality. The student-teacher ratio varies across fields and different learning modes (distant/blended learning, contact teaching, lab hours, seminars). Furthermore, it may have a negative effect on the willingness of HEIs to merge (for example, with PROs) because the

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[34] The scientific potential factor refers to the average of research unit category based on the research evaluation.

inclusion of higher numbers of staff would adversely affect the student-teacher ratio and the pressure for retirement would grow.

The funding formula for PWSZ (see Figure 20) **aims to address key challenges in a sector which is enduring a drop in enrolments**: during the period 2007-2015, PWSZ enrolments fell by 28 % for full-time study and 56 % for part-time study. This implies that the income from student fees has dramatically declined while public funding dependency has grown. The revenues of public PWSZs are based mainly on teaching activities (93.44 % of total revenue) and the primary source of income is budget funding (86 %)[35]. Fees for educational services have declined from 14 % to 8 % in just a few years, while the fall in the number of students has doubled since 2012. Funding from foreign sources and national co-financing have both dropped (co-financing has fallen from 6.47 % to 3.74 %). Remedial programmes are used for PWSZ if the sum of its net losses over a period of five years exceeds 25 % of the grant from the previous year.

The new funding system continues to fund PWSZ on historical funding (50 % constant), whereas half of the funding is formula-based covering three elements: 55 % for student enrolment with weights on practical training which is funded by the MNiSW (rather than the employers), corrected with a teaching availability factor, and 40 % for teaching staff with different weights for different categories, notably the highest being for professors from abroad. A small share of 5 % is allocated on the basis of external income.

In the panel's view, it is questionable whether the challenges facing the vocational higher education sector – declining enrolments, modest attraction for school leavers and generally low industry collaboration – can be addressed by these measures[36]. Developing a robust higher vocational education sector along the lines of UAS and the German dual universities would require an injection of fresh funding in the system (see Chapter 3 for more on higher Vocational Education and Training – VET).

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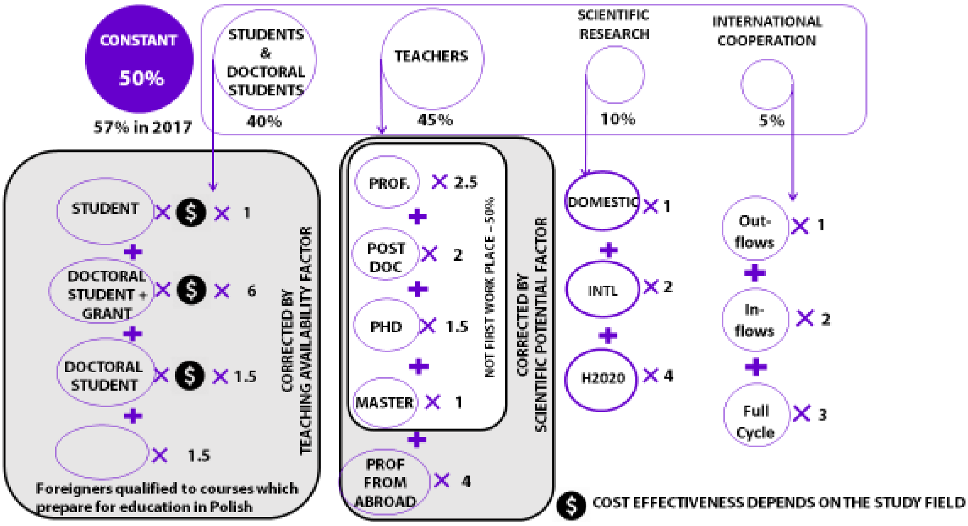
[35] The share of government grants to 34 PWSZ created before 2007 has gradually declined, whereas the two newer institutions established between 2009 and 2011 by the ministry of national defence in Dęblin and Wroclaw represent a growing share of public funding due to an increase in enrolments (from 0.6 % in 2011 to 4.7 % in 2016).

[36] This is because enrolment in vocational higher education does not depend on their funding but on the prestige of the vocational higher education and positive employment outcomes (whether graduates can expect to get the kind of job the students aspire to).

Figure 19: The formula for core-funding allocation to university teaching

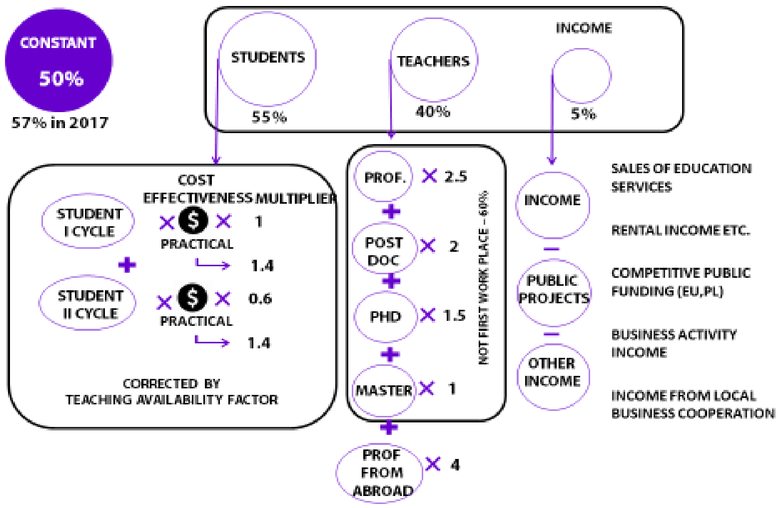
Four components, their respective percentage in the overall formula and the breakout into subsequent elements



Source: MNiSW

Figure 20: The formula for funding allocation to higher VET institutions

Three components, their respective percentage in the overall formula and the breakout into subsequent elements



Source: MNiSW

4.2.2.2 Resource allocation for statutory research activities

The core funding for statutory research is allocated annually by the MNiSW to scientific units in universities and PROs, based on the outcome of the research evaluation (Comprehensive Evaluation of Scientific Units) which is conducted every four years. The funding per unit is calculated according to the number of researchers, cost effectiveness[37] and the attributed research unit quality category. (The best-performing research units receive the A+ or A research category, good ones, B and the least-performing, C.) In the process of distributing the statutory research funding, the attributed categories of scientific units play a major role. The importance of the category is based on the values in the algorithm which are set annually[38]. As the evaluation is conducted every four years, the categories attributed are permanent until the next evaluation. The formula for core-funding allocation for statutory research to scientific units is explained in Figure 21)[39].

The current system of funding research based on a mechanical link with the research quality evaluation is not the best way to incentivise high-quality research performance, given the focus on quantity rather than quality (irrespective of whether it focuses on scientific units or fields, as planned for the future). In line with the policy practice in other EU and OECD countries, the panel suggests that the link between the evaluation system (SEDN) and funding allocation should be abolished. While the system could be further developed, and used as a policy instrument to help monitor and inform HE and science policy (including related strategies and plans, the effects of the EU funding, etc.), the government should evaluate the costs and benefits of maintaining the SEDN system. When the aim is to incentivise high quality and high performance, the number of parameters in the funding formula should be limited and the formula built in a transparent and simple way to enable HEIs (and other PROs) as well as individual researchers to easily identify what change in behaviour will yield better rewards. The current instrument helps the MNiSW to distribute the money but will not help incentivise quality improvements (see also Chapter 4.4 Quality assurance and evaluation).

There are also weaknesses in the current system for statutory research funding related to the method of distributing funds, its emphasis on quantity over quality as well as the transparency and predictability of the system. Allocation of funding for statutory research to scientific units instead of universities is a cause for concern as it deprives the university the ability to use the funding strategically and facilitates fragmentation of the

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37 Here, cost effectiveness refers to the estimated cost of research calculated for various fields of science on the basis of provisions set out in the Act of 14 March 2003 on scientific degrees and scientific titles as well as degrees and titles in the field of the arts.

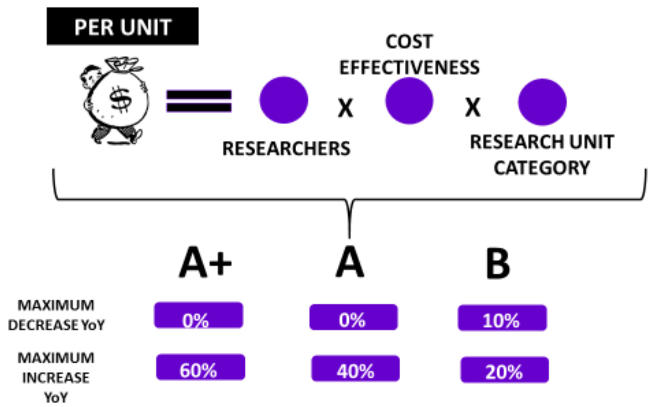
38 In addition to core funding for statutory R&D, the MNiSW also supports R&D by direct support for: (i) investments in R&D infrastructure; (ii) international cooperation; and (iii) scholarships and awards, e.g. for young researchers.

39 In 2014, the statutory funding for all scientific units amounted to PLN 2.2 billion and constituted 31.38 % of Poland's entire science budget. The rest of the national research budget (68.62 %) was allocated to the NCN, NCBiR and other areas.

universities (see Chapter 4.1 on Governance for more details, as well as the Learning Model on Institutional funding allocation models in five universities). The system would also benefit from greater transparency in determining the final criteria and results. For example, the final evaluation criteria for 2013-2016 was announced at the end of December 2016 after three changes, which pushed academia to increase the quantity of publications, rather than the quality.

Figure 21: The formula for core-funding allocation for statutory research to scientific units

Based on the quality score achieved in the evaluation of scientific units (research unit category)



Source: MNiSW

4.2.3 Resource allocation through competition

Following the reform of science and HE in 2010-2011, the focus of R&D funding allocation was reoriented towards competitive project-based funding. About 50 % of the R&D budget resources are distributed on a competitive basis mainly by the two agencies supervised directly by the MNISW. The National Science Centre (NCN) supports fundamental research through a system of competitive, peer-reviewed grants, and the National Centre for Research and Development (NCBiR) finances strategic R&D programmes and mainly supports applied R&D in business enterprises and science-industry consortia. In 2017, the NCN funding amounted to PLN 1.30 billion (all national funds), while NCBiR distributes a much larger sum of PLN 2.67 billion, including PLN 1.5 billion of EU funds. (For more on financing pro-innovation activities, see Chapter 6 on Third mission.)

The government's decision to make increasing use of competitive funding is commendable as it is an effective and flexible resource-allocation mechanism. Interviewees consistently argued that the competitive allocation mechanisms of the NCN and NCBiR had improved. In order to enhance the system, the following points should be taken into consideration:

- The best competitive funding systems apply transparency through the establishment of clear criteria and procedures, and the creation of an independent international evaluation and monitoring committee. Given the large number of funding streams and low remuneration for evaluators, funding agencies face challenges in identifying competent international evaluators, at least in leading research countries. There is anecdotal evidence that international evaluators systematically award lower points which has a limited impact on the outcome as only the points average counts.

- The right balance between statutory and competitive funding depends on the degree of funding for overhead costs. Different overhead costs are used in NCN- and NCBiR-funded projects (see Box 4.3). The panel stresses that the competitive funding should be accompanied by a sufficient funding of overhead costs, the level of which may range from 20 % to 60 % (minimum defined by the ERC grants, the maximum is based on calculations by the European University Association and US studies). Large research institutions will handle several thousands of individual grants and contracts which requires a sufficient core research budget to form a long-term and solid foundation for a variety of shorter-term projects. When the leading HEIs move towards more high-stake competitions with external funding that must be matched with institutional funding, this may tie up too high a proportion of the total budget and limit the institutional capacity for strategic planning and risk taking.

- The narrowly defined funding criteria of the NCN and NCBiR funding streams may be a challenge. NCN funding can only be distributed among a limited number of research teams, whereas NCBiR focuses on companies or research consortia driven by companies, with no direct funding to HEIs (they can benefit from the funding by being a contractor or part of the consortium) (see Klincewicz & Marczewska 2017). This leaves little incentive for mid-range institutions or academics over 35 years with limited scientific achievements to improve their performance because they are *de facto* excluded from competing for these grants. There are also concerns that current competitive funding schemes are either too discipline-oriented, thus disincentivising interdisciplinary action, or are too closely linked to established companies and industries. There is a lack of competitive funding to address Polish society's emerging needs. Like other European countries, Poland needs to shift its research capacity towards societal or economic challenges which can be addressed by interdisciplinary research. (For other gaps, see Chapter 6 on Third mission.)

- A cause of concern is the reliance on many small-scale and short-term competitive funding streams (labelled by Polish scientists as "grantoza" or "grant-based illness"). At the time of the review, NCBiR was running 52 types of initiatives, while the NCN had about 15 funding streams, many of them specially requested by the MNiSW. The funding streams of both agencies may benefit from some rationalisation. In the case of NCN, the separate funding schemes facilitate the attraction of applicants according to career stage as well as selection, but some economies of scale should be achieved.

Box 4.3: Overhead costs in NCN and NCBiR-funded projects

In NCN-funded projects, the overhead costs range from 20 % to 40 % of direct costs. A 40 % threshold was set in the recent calls (e.g. SONATA BIS, HARMONIA, OPUS and MAESTRO), while for the PRELUDIUM (pre-doctoral grants) the maximum level of overhead cost is 20 %. A trend can be observed of increasing the maximum level of overhead costs from 30 % to 40 % in calls related to SONATA BIS, HARMONIA, OPUS and MAESTRO, whereas the maximum threshold of overhead cost in PRELUDIUM has fallen from 30 % to 20 %.

This situation differs from NCBiR projects where the beneficiaries are mainly enterprises. Taking into account the high number of recent and ongoing calls, it is difficult to determine the precise level of overhead costs, which depends on the type of beneficiary. For example, in the 'Demonstrator' call (scientific research activities at demonstration scale), the maximum level of overhead costs for companies is 8 % and 15 % for scientific research institutions.

In addition to the MNiSW and its two funding agencies NCN and NCBiR there are several other agencies and funds that financially support research, development, innovation and entrepreneurship. The scope of the current review does now allow for a full evaluation. However, the diversification is justified when agencies have different funding missions and address niche areas, which can also contribute to differentiation in the HE system. The best systems regularly evaluate every mechanism to determine whether it is still warranted and serves its intended purpose. For the sake of transparency, all government funding should be combined into a national research, development and innovation budget.

Box 4.4: Other relevant funding agencies

- Polish Agency for Enterprise Development (PARP) supports innovation and entrepreneurship, including funding for start-ups and industrial development;

- National Capital Fund (KFK) manages venture capital funds based on co-funding from the EU Structural Funds, 2007-2013;

- Polish Development Fund (PFR) – newly established sovereign fund that is expected to play a key role in future R&I funding;

- Industrial Development Agency (ARP) – coordinates management of selected state-owned enterprises and making venture capital and other equity investments in innovative companies;

- Foundation for Polish Science (FNP) – a non-governmental institution which distributes ESIF funding targeting public science;

- Vitelo Fund – newly created fund of funds that will hold shares in VC funds, based on ESIF, to offer equity investments in innovative high-tech companies;

- National Fund for Environmental Protection and Water Management (NFOŚiGW) – financed from environmental fees and ESIF, and offering dedicated, substantial R&I funding for eco-innovations.

4.2.4 Performance agreements and performance-based contracts

A key element in ensuring improved performance is to better manage currently available resources, as additional marginal resources will not change the underlying culture. Leading research universities and other HE institutions across the world are seeking to better manage their resources to ensure critical mass, focus and the effective communication of their research.

The MNiSW could facilitate this process in Poland by allowing greater flexibility in the remuneration of HE staff and by establishing performance agreements. Such agreements could be established with key research-intensive universities through targets for growth in the number of publications, etc. (relevant for global university rankings) and for qualitative changes, as well as other institutions in line with the institutional type/profile. So far, performance agreements do not seem to be part of the portfolio of the planned reforms.

Performance contracts between the government and individual HEIs set out quantitative or qualitative targets for institutions to be achieved in a given time period and may be linked to institutional funding. The performance agreements typically set out overall institutional strategy (including the profile of institutions within national HE systems), as well as quantitative and qualitative targets relating to teaching, research or other institutional activities.

Performance agreements can be linked to funding in at least three different ways. Given the ambition to shift the focus from quantity to quality and the institutional profiling and mission diversity, the MNiSW could find inspiration particularly from the third option, i.e. linking financial consequences to the conclusion of the performance agreement as well as attainment of the objectives, as was the case in the Netherlands. See the Learning Model 4.2.7.1. on Performance agreements and performance-based funding in the Dutch higher education[40]:

- **Institutional agreements can be used as a basis for negotiating the upfront allocation of part of the public funding.** For example, in Austria, the university performance agreements set out what the government agrees to pay over a three-year period, covering a large part of public institutional

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[40] The discussion and examples in this section are based on lessons from the peer-learning activity (PLA) under the ET2020 working group on higher education, more specifically the PLA meeting in the Hague on 25-26 September 2014.

funding. Performance towards targets is taken into account in future negotiation rounds, but there are no fixed financial penalties if targets are not reached.

- **Performance agreements can be used as part of a funding and performance system, where a proportion of public funding is allocated using output-based formula.** For example, Finland uses performance agreements with both universities and universities of applied sciences as a strategic planning tool. Targets for specific indicators (for example, the number of bachelor degrees completed) are set out in performance agreements, but the funding allocation depends on a standard formula system (distinct formulas for universities and universities of applied sciences) rather than the performance agreement.

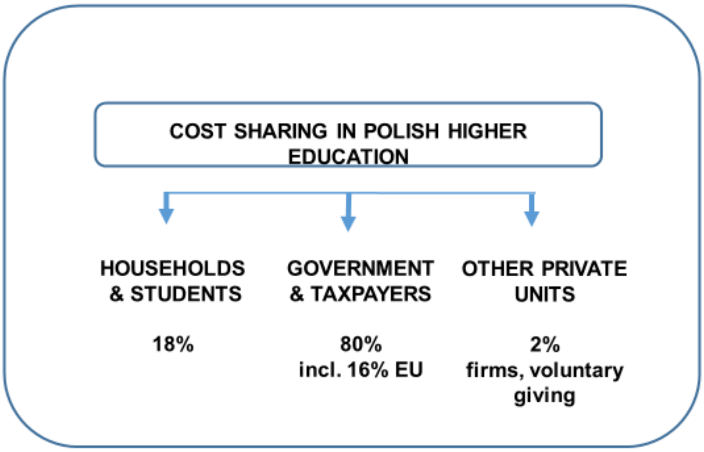
- **Explicit financial consequences can be linked to the conclusion of performance agreements and the attainment of objectives**. In the Netherlands, performance agreements, which were launched in 2012, are used alongside output-based funding formula. HEIs competed for 2 % of the public higher education teaching budget that was awarded based on the quality of the development plans submitted by institutions, while an additional 5 % of the teaching budget was made conditional upfront on having a performance agreement and, for the next period, on reaching quantitative targets specific to each institution and agreed in the plans. If institutions did not achieve their quantitative target, they lost part, or all of their share of this 5 % from 2016 onwards. See the Learning Model on Performance agreements and performance-based funding in Dutch higher education.

While linking non-attainment of targets in performance agreements to clear financial consequences for institutions is advisable, the amount of funding at stake should be sufficient to act as an incentive, but not too high to risk the financial stability of individual institutions. To prevent financial instability and create a positive incentive, funding linked to performance agreements should ideally be in addition to existing funding. "Top-slicing", whereby a proportion of existing funding (in absolute or real terms) is conditional on achieving set goals, is likely to be more controversial and potentially risky in an untested new funding system. The MNiSW could also consider building transition or improvement periods into policy, giving institutions that fail to meet targets additional time or a 'second chance' to enhance performance before the full financial penalty is applied. The focus should be on scale of improvement rather than absolute levels. Establishing an independent committee is important for the credibility of the assessment of qualitative aspects of plans.

4.2.5 Higher education cost sharing and diversification of funding

The balance between public and private financing of HE, and between households and other private contributions varies across countries. Poland stands out for its small share of business funding and high share of household funding. In 2013, 20 % of Poland's funding for HE came from private sources: 18 % from households and only 2 % from other private contributions, such as business[41]. While the OECD average for household expenditure amounts to two-thirds of private expenditure, in Poland, this share is 90 % (OECD 2016c). Polish business contribution is at a modest level in contrast to, for example, Nordic countries where nearly all private funding comes from private entities other than households, and generous student aid is available despite the lack of or low tuition fees.

Figure 22: Cost sharing in Poland's HE system



Source: OECD EAG data and MNiSW for the EU

The Polish HE system offers limited funding support for students with little effect on the redistribution of education costs. In principle, HE in Poland is free, but fee-based education is available in both public and non-public institutions, covering a quarter of all students. The system places a financial burden on families, but unlike countries where this burden is alleviated by public subsidies, Poland provides limited support for students with little effect on the redistribution of education costs. Interviews confirmed that student aid is available in both public and private HEIs, but does not adequately support needy students. Student grants are modest in relation to the cost of living, and the supply of loans is limited. While household contributions to HE are expected to decline with the drop in demand for paid education, the issue of equity in HE will not disappear.

The worsening dependency ratios[42], declining demand for fee-based education, and the planned HE system configuration highlight the need to eventually reopen the debate about greater cost-sharing, including

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[41] Poland (along with Estonia and Slovenia) registered less private spending in HE in 2013 than in the pre-crisis period 2008, with private contributions declining by 9 percentage points due to a fall in the number of fee-paying students.

[42] The dependency ratio is an age-population ratio of those typically not in the labour force (the dependent part aged 0 to 14 and 65+ years) and those typically in the labour force (the productive part aged 15 to 64 years). It is used to measure the pressure on the productive population.

tuition fees for full-time study. Apart from systems underpinned with high and progressive taxation, few countries have been able to restructure and improve the quality of the HE system without cost-sharing between the government and students. Given the plans for developing a stronger hierarchy among HEIs, the government should avoid enhancing the regressive elements whereby students from advantaged backgrounds tend to access high prestige universities disproportionately at no private cost and to obtain higher remuneration as graduates, while relying on less-advantaged taxpayers to fund their education. The introduction of tuition fees in full-time public education could provide a solution, but would require a change in the Constitution as well as much stronger student aid systems to ensure that financial barriers do not constrain academically qualified students from disadvantaged groups.

The third-mission activities of Polish HEIs remain underdeveloped with significant scope not only for outreach and service to society, but also for resource diversification from business and adult education. Despite variations across institutions, Polish public HEIs show a strong dependency on public funding. Underutilised sources for resource diversification include contract research, consultancies, continuing education, donations and other fund-raising activities. Polish institutions have significant untapped potential in continuing education at all levels. The MNiSW – and HEIs – could examine examples from the UK and Nordic countries in this domain. (See also Chapter 6 on Third mission.)

When taking steps to encourage resource diversification in HEIs, the government must acknowledge that the potential for resource mobilisation depends on the state of the surrounding economy as well as the training and research capacity of the institution. The MNiSW could consider introducing a national-level competitive funding to support university business and community engagement. The Higher Education and Innovation Fund for England (HEIF) provides an example of a long-term scheme which has weathered government changes and evolved over time. While HEIF funding has been a small component of the budgets of English universities, its cumulative impact on universities' behaviour has been significant and its launch has led to an exponential growth of community and industry engagement by institutions (PACEC 2012). The HEIF funding mechanism is noteworthy because it enabled HEIs to raise more funding from industry partners and because it was accompanied by a monitoring system (Higher Education and Business and the Community Interaction Survey HE-BCIS) which could provide further inspiration to the Polish parametrisation system. See the Learning Model 4.2.7.2. on the Higher Education Innovation Fund for England.

Investment in the fund-raising infrastructure could generate real rates of return for Polish HE despite the lack of tradition in this area. Most Polish universities have yet to take significant action to diversify their funding streams through voluntary giving, for example, by engaging with alumni, or seeking charitable donations, trusts or wealthy donors. The government could consider mobilising universities to raise private funding and professionalise its fund-raising activities. Countries like Finland and the United Kingdom have sought to stimulate this activity by matched funding schemes. In Finland, matched funding schemes have been used on two different occasions and have contributed to a cultural change in both society and HEIs. In 2010-2011, the matched funding scheme was combined with university reform and mergers: for example, Aalto University, which brought together three different institutions, was established from significant funding contributions from the private sector, while Helsinki University raised EUR 20 million which was the matched with EUR 50 million from the state. In 2014, following significant cuts in public funding to HE and science, the Finnish government launched a matched funding scheme, announcing that every euro would be matched (with up to three euros up to a total state funding of EUR 150 million). Between November 2014 and 30 June 2017, universities raised a total of EUR 145.4 million, with Helsinki University leading the way with EUR 48 million, including EUR 30 million to be matched later by government funding. All but two universities reached their self-declared targets. While the sum raised through donations is small compared to the total annual funding for universities (EUR 700 million for Helsinki University), and does not solve institutions' financial challenges, donations provide an opportunity to fund and incentivise important strategic priorities, such as quality teaching and innovation, and to highlight the importance of HE in society creating willingness to support public HE and research. Matched funding schemes also help build capacity among HE administrative staff as they require universities to build their financial management capacity to be able to invest the money (from donations and matched funding) profitably and use the profits strategically. For example, Helsinki University has about 100 staff, professors or associate professors financed by the profits from these funds. A similar scheme was recently announced by the government for UAS in Finland. In the Finnish scheme, the level of state matched funding will depend on the amount raised by each university. Given the goal to develop a diversified HE system, Poland could take a closer look at the UK matched funding scheme which was based on a three-tier system for different types of institutions. This scheme was also backed up with support for joint capacity building for institutions for fund-raising activities. See the Learning Model 4.2.7.3. on the UK matched funding scheme for charitable donations.

4.2.6 Recommendations on funding

Poland's long-term development depends on its ability to train and retain highly skilled people who can lead the productivity gains and innovations needed for sustainable growth and development. This requires defining and implementing a sustainable financing strategy to support the HE, science and innovation reform and the quality improvement objectives. A sustainable financing strategy entails three complementary dimensions: (i) mobilising sufficient resources; (ii) developing allocation methods that encourage innovation, excellence and effective use of available resources, and (iii) making sure that the public subsidies spent for education purposes ensure equitably access and success in HE.

Design a sustainable financing strategy with long-term goals.

- Design a sustainable financing strategy aligned with the long-term strategic goals and conditional on reforming the system in order to increase the quality and efficiency of investments, keeping in mind that the shape and institutional configuration of the HE system will largely determine the cost of operating HEIs and that the reform will require fresh sustainable funding for the system. Underpin the long-term commitment to HE and science and innovation with a sustainable financial expansion plan, mobilising both public and private resources to meet the needs for quality improvements, system configuration and R&D expansion. In so doing, the government must ensure that the design and operation of funding mechanisms are transparent (e.g. policy objectives, procedures for resource allocation, etc.) and the different instruments are compatible.

- **Implement a two-pronged strategy:**

  – **mobilise an increasing share of public expenditure for HE in the budget.** In line with the various reform proposals (for example, Kwiek et al.) allocate sufficient resources for universities as a precondition for meaningful reforms. This could entail introducing an investment target for efforts in the HE and science and innovation system and ensuring the greater predictability of funding with three- to four-year rolling budgets of formula-based block grants for core funding combined with competitive grant schemes and possibly performance-based funding. It is crucial to inject fresh money to the system to underpin the existing pockets of international excellence in the R&I system, rather than distribute additional resources across the HE landscape. Law 2.0 and complementary measures could be used to nurture Polish consortia, both from inside and outside universities, to create a broader knowledge base and innovation (including spin-offs and start-ups) in ICT and health, the two thematic areas in which Poland is most active in HORIZON 2020[43].

  – **encourage resource diversification in the HEIs.** Encourage HEIs to generate more external income, recognising that the potential for resource mobilisation depends on the state of the economic environment and the institution's training and research capacity. Commonly used external funding sources are tuition fees, contract research, consultancies, continuing education, donations and other fund-raising activities. There is significant untapped potential in continuing education which remains under-developed in Poland at all levels, as well as donations and voluntary giving. Given the goal to develop a diversified HE system, Poland could consider the UK matched funding scheme which was based on a three-tier system for different types of institutions, as well as Finland's more recent experience (see the Learning Model).

- **Consolidate the HE sector to avoid waste and inefficient use of public resources.** To protect universities' resource base, develop a robust non-university HE sector in the form of UAS and distance education and blended learning models. A well-functioning UAS sector can make an important economic and social contribution by offering training and R&D opportunities that respond to labour market/industry demand, at the regional level, too. The development of cost-effective distance education and blended learning

[43] The greatest number of applications were in ICT-694, ENE-538, SOCIETY-526 and HEALTH-475. The most popular projects were ICT-50, HEALTH-30, ENERGY-29 and FOOD-26. Most coordination was in ICT-9, TWINNING-7, ENE-3, TPT-3, and HEALTH-0.

models helps ensure student access in peripheral areas and lower socio-economic backgrounds (see Chapter 3).

Ensure sufficient need-based student aid and consider cost-sharing in full-time study programmes.

- Review the current student support system to ensure the key principles of HE funding – cost-sharing, relevance and comprehensive student support. Ensure adequate and sufficient student aid, including targeted needs-based grants, scholarships and student loans.

- Reassess whether the cost-sharing balance between government and households is desirable and reflects the relative importance of the private and societal benefits of HE. To create a more diverse funding base for institutions and ddress the regressive elements of the public HE system, reopen the debate of introducing student fees for full-time study in public HE, backed up with a stronger student-aid mechanism to ensure that financial barriers would not constrain academically qualified students from disadvantaged groups.

Develop a broad scale of funding allocation mechanisms.

- **Develop the HE funding formula to improve the quality, relevance, accountability and efficiency of the institutions.** Consider introducing a limited number of transparent indicators, a clear link between indicators and strategic goals to help the government to steer the HE and science system in the desired direction. This would imply abolishing the mechanical funding allocation for research on the basis of the evaluation of scientific units (or fields). A transparent and objective way to distribute funds for recurrent expenditures is to use a formula linking the amount of resources spent on inputs (for example, number of students or academic staff) to an indicator of institutional performance (such as the number of graduates). In Denmark, 30-50 % of recurrent funds are paid to the HEI for each student who passes exams. In Australia, funding for doctoral places is based on a formula comprising graduation (40 %), research outputs (10 %) and research income (50 %).

- **Ensure institutional budget autonomy** for at least the big institutions, balancing it with accountability and some state control. The recent EUA studies on budget autonomy of universities in Europe has defined the key elements of budget autonomy, including transfer of funds in the coming years. For example, Aghion et al. (2008) stress the importance of budget autonomy for the efficiency of resource allocation and improvements in HEIs.

- **Continue to make use of the competitive funding schemes.** Consider using competitive funding to reward proposals designed to achieve institutional improvement or national policy objectives, such as flagship universities. Poland could use competitive funding mechanisms to encourage HEIs to undertake strategic planning activities related to system configuration and consolidation. Currently, most of the competitive funding (for research) accrues among only a few universities. Poland could also learn from HE systems which have developed large-scale schemes for excellence (Germany and France), or have embedded excellence in regular recurrent funding (UK). Some schemes, where a large share (30 %) of research funding is allocated using competitive mechanisms, include large and long-term grants (EUR 5-10 million for 10 years). Examples of this type of funding include the science and engineering centres in the United States in the 1980s, centres of excellence in the 1990s, ERC advanced grants, etc. Belgium, however, does not have long-term grants but to a large extent still depends on competitive funding.

- **Consider introducing performance agreements negotiated between the government and selected HEIs in order to set performance-based objectives, backed up with additional funding. Part of the funding may be based on whether institutions meet the requirements in the contracts.** The agreements can be funded prospectively or reviewed and acted upon retrospectively. When linking non-attainment of targets in performance agreements to clear financial consequences, care should be taken to ensure that the amount of funding at stake is sufficient to act as an incentive, but not too high to impose a risk to the financial stability of individual institutions. For the same reasons, funding linked to performance agreements should ideally be additional to existing funding. 'Top-slicing', whereby a proportion of existing funding (in absolute or real terms) is made conditional on the achievement of goals is likely to be more controversial and potentially risky in an untested new funding system. See the Learning Model on Performance agreements and performance-based funding in Dutch higher education.

- **Where appropriate, use the funding system to create stronger incentives for the local and regional engagement of HEIs in the form of long-term core funding (which could be allocated by a formula against outcomes) or additional strategic incentive-based funding schemes.** The funding system could include: i) formulas for block grant funding with higher weights for enrolment of students from special populations (e.g. students from lower socio-economic backgrounds) or for enrolments in academic programmes related to regional labour market needs; ii) eligibility for additional funding could be contingent on evidence of regional engagement and focus, requirements that institutions collaborate in order to obtain funding (with the minimum requirement of at least two HE institutions), and to match funding secured by universities from contracts with regional employers for education and training services.

4.2.7 Learning models

4.2.7.1 Performance agreements and performance-based funding in Dutch higher education

During 2008-2011, the Dutch government implemented collective performance agreements for the research university and the UAS sectors. Due to the disappointing results, institutional performance-based agreements were launched as an experiment in 2012 in line with the recommendations of the so-called Veerman Report which called for a focus on quality improvements rather than quantity (more students). The report proposed HEI-based profiles and a reduction in the share of student-based funding in favour of mission based-funding. The idea was to reward HEIs for profiling and related achievements, and to encourage differentiation in the programme offer.

The Strategic Agenda for HE, Research & Science (June 2011) introduced institutional performance agreements for publicly funded UAS and research universities, as well as performance-based funding as a new component in the HE-funding model (quality and profile). The general aim was to combine three goals: raise the quality standards, improve HE completion and access, and reduce the number of dropouts.

In December 2011, the HEI-specific contracts were preceded by general agreements between the secretary of state and two HE sectors. HEIs were then asked to design a strategic plan with: (i) a description of the institution's current profile; (ii) an analysis of its strengths and weaknesses; and (iii) ambitions for the years 2012-2016 to improve educational achievement (quality of education), enhance its educational and research profile, and increase the impact and application of research. The plans were expected to be founded on each institution's own strategic goals and objectives based on their history, context and student population.

Institutions were required to formulate targets for 2015 for seven mandatory indicators:

- Dropout rate of year-1 first-cycle students;
- Study switch rate of year-1 first-cycle students;
- Completion rate of 2nd-year students;
- Quality/excellence based on three possible indicators: (i) percentage of programmes with a 'good' or 'excellent' assessment by the national quality assurance agency; (ii) student satisfaction: % of students giving positive feedback on the study programme (4 or 5 in the 5-point scale; and (iii) percentage of students in the excellence (honours) tracks;
- Teacher quality (master's/PhD in the UAS, basic qualification in teaching in research universities);
- Educational intensity: minimum standard: 12 face-to-face hours a week in the first year for each bachelor programme;
- Indirect costs (overheads).

Strategic plans were evaluated by an independent review committee against three criteria: (i) ambition and realism; (ii) feasibility; and (iii) alignment with the national policy priorities such as diversity in programme offer and innovation policy priorities (double weight factor in the final score). The guidelines prescribed that in case of a positive evaluation, the plan would be accepted and the minister and HEI would conclude a performance agreement.

In November 2012, all Dutch HEIs made a performance agreement with the minister in charge of higher education. The agreements prescribed that 7 % of the education funding be tied to performance agreements, in two parts: 5 % on 'conditional funding' and 2 % on 'selective funding'. A valid performance agreement was a precondition to get 'conditional funding' (5 %) for 2013-2016. The budget for selective funding (2 %) for 2013-2016 was competitive: universities with better plans got a larger part of this budget (scores 'good', ‘very good’ and ‘excellent’ were weighted differently, i.e. by factors of 2, 3, 5 in the budget).

In autumn 2014, a mid-term evaluation by an independent review committee confirmed whether or not the HEIs had started to implement their plans. In cases of insufficient progress, the HEI would lose its share of the budget for selective funding in 2015 and 2016.

For the final evaluation at the end of 2016, the guidelines prescribed that in case of non-attainment of targets in 2015, the institution would receive a smaller share (minus 1/3, 2/3 or all) of the ‘conditional funding’ (5 %) for 2017-2020. All research universities and most of the UAS reached their goals for 2015. Given the tough challenge facing the UAS to improve quality and the completion rate at the same time as maintaining equity in access, the minister decided to halve the ‘penalty’ (minus 1/6 of the conditional funding instead of 1/3) for 2017 for the six UAS which did not reach the targets in study success. The results of the evaluation of the system of performance agreements and performance-based funding by an independent evaluation committee were presented in March 2017. In addition, the independent review committee, mentioned above, made an evaluation, based on its own experience.

After the general elections in March 2017, and with the formation of a new cabinet still in progress (July 2017), the new minister will make a decision on how to continue the quality-based funding and quality agreements with HEIs, taking into account the evaluation committee’s advice.

Consequences: performance agreements enhanced the alignment between the national agenda and the institutional agendas. The experiment generated high-quality and ambitious institutional strategic plans, focused HEIs’ attention on priorities and ways to reach their targets, and generated 20 centres of expertise, i.e. practice-oriented research centres in the UAS to upgrade the higher professional education. There were also some unintended consequences: some HEIs focused strongly on reaching the targets which, in some cases, compromised their efforts to improve quality and study success. In some cases, HEIs increased the size of the study groups to reach the targets. The need for a formal regulation led to a bureaucratic process. The government changes had an effect on the system: for the first time, changes were made to limit opportunities for student selection at entry.

4.2.7.2 The Higher Education Innovation Fund

The Higher Education Funding Council (HEFCE) launched the Higher Education Innovation Fund (HEIF) in 2001 to support and develop a broad range of knowledge-exchange activities that result in economic and social benefit to the UK. The HEIF provides special funding to universities to support activities which increase their capability to respond to the needs of business (including companies of all sizes and sectors and a range of bodies within the wider community) where this will lead to identifiable economic benefits. Early rounds of HEIF built capacity and provided incentives for all English institutions to work with business, public-sector bodies and third-sector partners, with a view to transferring knowledge and thereby improving products, goods and services. Following 10 years of capacity building, from 2011 HEIF became performance-based and was awarded to 99 English HEIs.

HEIF has gone through several iterations:

- Round 1 (AY2001-2003): 136 applications for funding from 128 HEIs, including 34 proposals from thematic and regional consortia involving several HEIs. Funding of over GBP 77 million to 89 institutions.

- Round 2 (AY2004-2006): 183 applications for funding, including 69 from consortia of HEIs. Funding of GBP 186 million allocated to 124 proposals, including 46 consortia, and 22 new centres for knowledge exchange established.

- Round 3 (AY2006-2008): GBP 238 million allocated to all HEIs through a combination of formula funding based on data collected via the mandatory Higher Education Business and the Community Interaction Survey (HE-BCI), and collaborative competitive projects. Three elements of the formula: i) potential and capacity building; ii) external income as a proxy for demand; and iii) activities not best measured by income. Allocation per institution: GBP 200 000 to GBP 3 million. Accountability via submission of institutional plans and annual monitoring. 11 large-scale projects with several HEIs and external partners from business and community organisations and continuation funding for centres for knowledge exchange were also supported.

- Round 4: AY2008-2011: move to entirely formula-based allocations of GBP 150 million per year over the period. Maximum allocation for an institution set at GBP 1.9 million per year in AY 2010-11. Formula allocations moderated by assessments of institutional knowledge exchange strategies and annual monitoring.

- Round 5: AY2011-15: funding maintained at GBP 150 million per year, despite the economic situation, thanks to the minimum return on investment of GBP 6 for each GBP 1 of HEIF money. Performance-based allocations for institutions if their external income earnings exceeded the GBP 250 000 threshold and their performance matched that of the sector overall (as captured in HE-BCI survey). Altogether, 99 institutions received allocations. Accountability was based on the submission of institutional knowledge exchange strategies and annual monitoring.

4.2.7.3 Higher Education and Business Interaction Survey (HE-BCI)

The HE-BCI survey covers a range of activities, from the commercialisation of new knowledge, through the delivery of professional training, consultancy and services, to activities intended to have direct social benefits. 'Business' in this context refers to private, public partners of all sizes and sectors, with which HEIs interact in a broad range of ways. 'Community' in this context refers to society as a whole outside the HEI, including all social, community and cultural organisations, individuals and the third sector. Data collection moved to the Higher Education Statistics Agency (HESA) in 2011.

Source: HEFCE (2012a) Funding for knowledge exchange - Higher Education Innovation Funding (HEIF), HEFCE, Bristol, www.hefce.ac.uk/whatwedo/kes/heif; HEFCE (2012b) Higher education-business and community interaction survey, HEFCE, Bristol, www.hefce.ac.uk/whatwedo/kes/measureke/hebci

4.2.7.4 The UK matched funding scheme for charitable donations to higher education institutions

In April 2008, the UK government launched a GBP 200 million matched funding scheme for voluntary giving. The scheme began in August that year for a three-year period. Funding was available to match eligible gifts raised by English HEIs and directly funded further education colleges. There were three levels of funding:

- First tier: 1:1 private to public: intended for the least-experienced fund-raising institutions and those looking to build capacity from a low base. Every GBP 1 raised will be matched in full.

- Second tier: 2:1 private to public: intended for the majority of institutions with existing development programmes. Every GBP 2 raised will be matched by GBP 1.

- Third tier: 3:1 private to public: intended for the most experienced fund-raisers. Every GBP 3 raised will be matched by GBP 1.

HEIs could request their own tier, with the exception of Oxford and Cambridge universities which were included in the third tier. All directly funded further education colleges wishing to participate in the scheme were automatically included in the first tier. Each institution's tier and cap level was confirmed by the Higher Education Funding Council (HEFCE) prior to the start of the scheme.

The following forms of giving were eligible for match funding: actual gifts of cash, gifts of shares, gifts from small/medium-sized charitable trusts and foundations, gifts through HEIs' own non-consolidated development trusts, corporate gifts and overseas gifts. Legacies and gifts in kind were not eligible for matching. HEIs had the freedom to decide how match funding was spent.

Source: HEFCE (2008) Matched Funding Scheme for Voluntary Giving 2008-2011. Circular Letter, No. 11/2008, HEFCE, Bristol, www.hefce.ac.uk/pubs/circlets/2008/cl11_08/

4.2.7.5 Institutional funding allocation models in five universities in Sweden, the UK and Germany

HEIs' strategic funding allocation systems typically combine the following elements: (i) base funding, performance-based funding, and strategic funding; (ii) performance-based indicators and set time periods for performance evaluation; (iii) the share to be retained at centr (i.e. university central administration) for specific investments and allocation at the discretion of the top management; and (iv) a system of allocation from faculty to department level (same allocation model or something similar). If appropriate, the performance-based funding allocation model should impact not only faculties, but also departments (and individuals). The following examples highlight the diversity of approaches of different types of HEIs. (The same distribution model does not need to be applied throughout the whole organisation):

- KTH Royal Institute of Technology (SE) applies an internal funding-allocation model with base funding, performance-based funding (for research and education), and a substantial proportion of strategic funding. This creates both stability and predictability for schools and departments, and a climate where good performance is awarded. The strategic funding provides the schools and in part the departments with freedom to choose where to invest extra resources.

- Chalmers University of Technology's (SE) funding allocation model uses an individual-based and a performance-based component – for both the funding stream to research and PhD training, and the stream to education at undergraduate level. 50 % of performance-based funding for education is dependent on provided courses and programmes and 50 % of performance-based funding for research is calculated through a combination of five indicators with different weights (bibliometrics, external funding, number of PhD exams, utilisation). Introduced in a staged manner over six years, the Chalmers' model creates substantial predictable funding at individual level at around 75 % of the costs.

- The University of Bristol (UK) uses a performance-based system to distribute funding based on the income generated by schools. The central management distributes funding to the faculties, depending on the schools' aggregated income. The faculty distributes the funding onwards to schools, at its own discretion.

- Loughborough University (UK) allocates funding from the central level depending on income on lower levels. The provost, who is responsible for the allocation, may use various available metrics, but is not obliged to do so. The benchmark for funding is each school's budget from the previous year, but each year between 1.5 % and 2 % is deducted, so the schools need to implement efficiency savings. The savings go to a strategic fund from which the schools can bid for extra allocations for special investments.

- The TU Berlin (DE) model distributes funding from the faculties to lower levels at the university, and mainly to funding specific areas of research. The professorial chairs are funded through base funding on a needs basis from central level, and funding for teaching is included in this stream. The redistribution of funding and the strategic distribution is devolved to faculty level.

Source: Melin, G., Kolarz, P., Zaparucha, E and Johann D. (2016). Universities' internal budget models. Six European case studies. Technopolis Group, June 2016

4.3 Human resources, doctoral training and career system

Whatever activity an HEI undertakes, its quality is determined by the quality of the human resources, the core faculty and research staff. The way to stimulate this key resource is to provide opportunities for the best talent to develop by engaging in independent research and other academic activities. Currently, Poland's HE and science system is failing to take full advantage of its talent. **This chapter analyses the two key areas needing reform: doctoral training and the career system. Without profound changes in doctoral training, and recruitment and career progress, Poland is likely to remain at the margin of the global knowledge economies.**

4.3.1 Doctoral training system

Doctoral training is a key challenge in Poland's HE and science system:

- **Poland lacks a robust system of formalised doctoral training and appropriately organised supervision of PhD candidates.** The current system is based on a traditional apprentice model in which the doctoral candidate is supervised by a habilitated professor. Given the massification of HE and the fact that two-thirds of Polish researchers are sedentary, it is questionable whether the habilitated professors are able to provide postgraduate students with coaching which matches world-class standards and prepares for talent circulation.

- **The current performance and results of doctoral training are suboptimal.** Half of the 40 000 doctoral candidates (2000 in the Polish Academy of Sciences research institutes) are inactive. The PhD graduation rate is low and most doctoral studies are prolonged. The graduation age is high compared to the OECD average, and PhD holders are relatively old and not flexible enough to permeate the market for advanced human capital. The existence of the habilitation degree lowers the level of PhD dissertations and PhD degrees and constitutes a loss to both taxpayers and institutions.

- **The inflation of doctoral training is accelerated by the current funding formula and the national system of evaluation of scientific units which incentivise the expansion of doctoral training rather than quality provision** (See chapter on Funding). This contributes to the low quality of PhD theses and the reluctance to eliminate habilitation which is seen as a guarantee for quality standards in academia. This in turn leads to a too-high average recruitment age for full professors (over 50 years), which is significantly higher than in most competitive HE systems and a conservative HE and science system (see section 4.3.2 for more details).

The way out of this dilemma is to reform the PhD programme. In countries such as Denmark, the reform of the doctoral programmes has preceded the expansion and reform of the HE and research sector because it was recognised that a fundamental cultural change in the research community was necessary to respond to accelerating technological change and increased demand for knowledge. Following the introduction of more structured PhD programmes, a number of EU countries invested in increasing the capacity of doctoral training and ensuring international quality standards. Such reforms have instigated changes in the career pathways into early research and academic careers, postdoc programmes, etc. In short, the successful modernisation and expansion of doctoral training has generated high levels of young and well-trained advanced human capital available to the research system, enterprises and universities.

The central argument for effective graduate schools and structured doctoral programmes is threefold. First, training the next generation of researchers means securing the future development of an academic discipline. PhD candidates are not only helpful in existing research groups, but today's talents are the inventors of tomorrow's technologies. **Second, advanced societies demand research skills for the development of industrial technologies to ensure growth and prosperity for these societies. Third, developing a specific emphasis on a selected group of the very best postgraduate students enables a university to balance**

between mass and elite programmes. Effective graduate schools, i.e. structured doctoral programmes bring many benefits: (i) talented young researchers bring new ideas and innovation to the universities; (ii) they influence education and contribute research results; and (iii) they enhance internationalisation. If the graduate schools are fully internationalised, these young researchers will contribute to the development of an important international network both inside and outside academia (see also Melin and Jansson 2006; De Grande 2014).

If Poland wishes to become a technologically advanced nation, state-of-the-art research competences need to be generated in larger numbers. Stimulation and training of Poland's best talent must be articulated with similar activities in advanced economies and have a broad focus on the wider labour market. This is best achieved by developing robust indicators to monitor outcomes such as doctoral employment rates and return on investment for PhDs.

The case study from Denmark is a useful example for Poland as it shows how the government and institutions can enhance doctoral training. In 2006, Denmark established a globalisation agreement with the aim of increasing the intake of PhD candidates in selected fields. The agreement was based on a consensus of major parties to increase investments in research to enhance growth and innovation capacity. As part of the investments, the universities were required to increase and improve their PhD training students in order to create a recruitment pool of highly educated researchers for both the private and the public sector. See the Learning Model 5.3.6.1. on Enhancing doctoral training in Denmark.

4.3.2 Industrial doctorates

Industrial PhD programmes have been implemented in European countries for many years (e.g. in Denmark, France, Germany, Great Britain, Norway) and, more recently, at the European level under the European Industrial Doctorates programme and in the EIT Knowledge and Innovation Communities. The country experience shows that industrial PhD programmes have positive employment outcomes: industrial PhD graduates find jobs more easily and earn a higher income than graduates from traditional doctoral programmes, while companies employing postdoctoral researchers benefit from greater patent activity and employ more staff. See also the Learning Model 4.3.5.2. on Denmark's industrial PhD programme.

Poland's recently launched (May 2017) competitive call for industrial doctorates (the Implementation Doctorate scheme) is commendable and informed by international best practice (see Box 4.4). The current launch phase should be evaluated by an international panel with relevant experience. As a rule, education systems should ensure that there are no dead ends but that functioning pathways are available for those wishing to continue their academic progress. One potential cause of concern is that the industrial PhDs will require an habilitation for continuing the academic path. The initial draft of the bill envisaged that industrial doctors would obtain entitlements equivalent to the rights resulting from having an habilitated doctorate, but this was removed from the bill in parliament.

Box 4.4: Polish Implementation Doctorate scheme

In May 2017, the MNiSW launched a competitive call for industrial doctorates backed up with an annual funding of a maximum of PLN 85 million per year (PLN 21 million for the first year) in order to recruit 500 PhD candidates for implementation doctorates. The first industrial doctorate students will begin their studies in autumn 2017.

A PhD candidate has two tutors: one appointed by the company (or a public-sector employer) and another in the public research unit (university or research institute of an A or A+ category) to ensure the quality of the research.

Industrial doctorates will carry out their PhD work in a research unit while, at the same time, solving the employer's authentic industry problem. The share of the time spent in the industry vs. university/research institute is at the discretion of the partners, allowing flexibility for different arrangements. The research unit, the PhD candidate and the employer will establish the research plan for collaboration. The PhD candidates are at the centre of the process and can suggest the research topic to a current or potential employer or the university.

Public funding will cover the scholarship for the doctoral student and subsidies for the costs of using the related research infrastructure in the research unit. The research unit, in exchange for providing access to laboratories, will receive funding from the scheme to be used for the research infrastructure but not for the supervision provided.

The doctoral candidate will benefit from double compensation: a salary for full-time employment from the employer and a scholarship from the MNiSW equivalent to the minimum basic salary of a university assistant (PLN 2450 in 2017).

See: http://legislacja.rcl.gov.pl/projekt/12290950

4.3.3 Career system in higher education and science

Irrespective of national differences in size, the profile of HEIs and PROs and the design and traditions of the national HE and science systems, any system of academic/scientific position needs to meet similar basic demands from the state, society and the academic system. It must: i) attract and nurture new talents in the system; ii) ensure retention of talent by providing attractive career prospects; iii) support staff members to fully utilise their potential; and iv) ensure that the scientific quality is maintained throughout the system and the individual's career.

The current Polish HE and science career system does not appear to take full advantage of careful recruitment standards or offer sufficient research opportunities to young talent. The impression is that many Polish academic staff and researchers are rarely benchmarked and assessed against a transparent set of quality criteria.

Poland's HE and science career system manifests a number of weaknesses and dysfunctionalities, such as[44]:

- **A delay in acquiring sufficient opportunities and resources to conduct independent research.** International evidence shows that research breakthroughs are typically made before the average age of habilitation in Poland (46.2 years, see Radwan et al. 2017)[45]. While the 2013 reform of the habilitation system may have helped to reduce this age, it is unlikely that Poland will be able to lower the average age to around 30 years. Furthermore, habilitation is only one of the hurdles on the long road to becoming a professor, the average age of which was 56.5 years in 2012–2015[46]. Institutional arrangements vary, but rather than using an international peer review, institutions decide on new professors internally. For instance, in the University of Warsaw, a committee of 10 former rectors take decisions about the new professors. There is also an overemphasis on the quantity of publications, rather than their quality, impact or citations in the procedures for attaining habilitation and the professor's title.

- A link between the number of staff with habilitation and the authorisation of teaching activities and degree awarding powers. Currently, the Polish HE system requires a minimum number of staff members with habilitation in order to authorise units to pursue teaching activities or award academic degrees. As a result, "the degree of doctor habilitation has become a rare (regulated) commodity which may be monetised by the group of its holders without any visible benefits for science" (Radwan et al. 2017). Staff with habilitation are difficult to remove from HEIs even if their scientific activity is almost non-existent and of a low level.

- **Academic inbreeding in recruiting junior staff** (see Batorski et al. 2010; Kosmulski 2015). In the period 1990-2007, 55 % of doctoral degree recipients were employed in the same institution that granted them their PhD (Batorski et al. 2010). Recent data show that in Jagiellonian University, about 90 % of the staff with a PhD had received the degree in the same university, with similar results for other major universities. This is in stark contrast to countries such as Germany, where approximately just 1 % of academic staff continue their career at the university where they defended their dissertations (Radwan et al. 2017).

- **Overwhelming sense of insecurity among the junior staff.** The contractual stability of academic staff is determined by the career stage, with junior academics facing precarious employment conditions. The teaching workload is defined according to academic staff categories, with a tendency to impose more teaching on junior academics who are also expected to

[44] For detailed discussion on weaknesses or dysfunctionalities, see Kwiek et al. 2017 and Radwan et al. 2017.

[45] For example, the Nobel Prize statistics show that researchers reach their top-point at the age of 30 to 40 (see Jones and Weinberg 2011). In Mathematics this may happen even before the age of 30). Older scientists can be effective team leaders/coaches etc.

[46] In Poland, the head of state officially grants the title 'professor'. Although this act cannot be considered a direct involvement of the public authority in the recruitment process, holding the title 'professor' is a condition to be recruited to such posts (Eurydice 2017).

perform on the research front. Young scientists face difficulties in accessing resources, building their own teams, undertaking research topics autonomously, international networking, and low remuneration at the time for typically starting a family (Radwan et al. 2017). For more information see Gorelova & Yudkevich 2015.

- **Gender bias in academia.** In 2015, 44.4 % of Poland's academic staff were women, compared to the EU average of 34.4 % (Eurydice 2017). The gap between men and women widens with rank: about one in five professors are women (22.7 % in 2013) (ibid.). With each formal promotion step in the career system, the proportion of women drops. In 2015, the share of habilitation degrees awarded to women was 44 % while the share of professor's titles to women was 28 % (down from 33.7 % in 2014)[47].

- **Low remuneration of academics and lack of flexibility in rewarding talent.** The median gross remuneration of PhD holders employed in HE was PLN 4000 per month compared to PLN 6500 for those employed outside of the sector. At PLN 3200, the average monthly salary in the science and education sector is among the lowest compared to other industries (Radwan et al. 2017).

- **Modest levels of internationalisation and a lack of foreign-born staff and PhD candidates.** The use of international peers in the public science system remains limited and, for instance, these are usually written in Polish. Most domestic journals publish in the local language and thus cannot benefit from inputs from foreign peers, even though many of them list researchers from other countries as members of journals' scientific boards. Foreigners constitute 2.4 % of academic staff at Polish HEIs (Radwan et al. 2017). The Jagiellonian University has just over 2 % of foreign-born academic staff, Mikołaj Kopernik University about 1.4 % and the University of Warsaw 7.8 %, compared to many universities worldwide with 15 to 40 % foreign-born staff[48] (see Radwan et al.). The figures for foreign PhD candidates are similarly low compared to most other countries (see Radwan et al. 2017). There is substantial room for improvement in attracting and retaining foreign staff and PhD candidates. For more information, see the chapter on Internationalisation.

- **A lack of systematic continuing professional development in pedagogical training.** The MNiSW has mandated pedagogical training for all new HE staff. Polish institutions have institutional autonomy in the area of continuing professional development. Other large-scale training programmes targeting academics have been launched with the help of ESIF funding but it is not clear what proportion of teaching staff benefits from these

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[47] http://stat.gov.pl/obszary-tematyczne/edukacja/edukacja/szkoly-wyzsze-i-ich-finanse-w-2015-r-,2,12.html

[48] In comparison, at Maastricht University foreigners account for 37.73 % of staff, the University of Warwick 39.01 % , the Technical University in Munich 19.6 %, Heidelberg University 18 %, the University of Vienna 40.22 %, the University of Geneva 59 %, the University of Zurich 52 %, Stanford University 47.63 %, Massachusetts Institute of Technology (MIT) 56.30 % (1679 people) and Harvard University 50.37 % (Radwan et al. 2017).

programmes. These programmes focus on improving the quality of teaching, information and communication technology (ICT) or foreign languages.

4.3.4 Developing a supportive career system

Transforming the recruitment and career progress system requires greater flexibility and a stronger focus on quality. The habilitation system is currently seen as a quality guarantee, a second test or passing to a mid-career phase with better access to research funding and improved conditions for research. International experience suggests that in Poland, on average, the habilitation comes too late in the individual's career, posing a barrier to scientific accomplishments. Habilitation can be removed if Poland improves the doctoral training system or institutions enhance the merit-based recruitment of PhD graduates to postdoc or other academic positions. If the government decides to maintain the habilitation, it could be transformed into a career step that functions as an incentive for and recognition of excellent research at postdoc level, but without the current limiting features such as those linked to the right to provide education and award degrees. Countries which have abandoned habilitation include Denmark, where regulations specify that candidates for the position of associate professor or professor must receive a positive peer assessment of their academic competencies and qualifications. In Germany, where habilitation is no longer required, candidates for the position of professor may be asked to prove additional academic achievements, or particular achievements in the application or development of academic or scientific knowledge and methods.

Improving staff performance. Employees of HEIs and PROs have to undergo regular performance evaluations, which include criteria related to scientific achievements, but these evaluations seem to remain a formality in most public institutions. Older staff benefit from tenure-like, permanent employment contracts and retain their positions regardless of performance, while younger researchers have temporary contracts that are not extended if they do not attract R&D grants or are publisedh in international publications. In the current system, individuals with a track record of years of underperformance may continue to receive research resources, which is draining resources and demotivating productive staff.

In the context of the current tenure-like contracts for older staff, universities have a limited scope for internal performance management towards greater focus on research and higher-quality outputs. **To overcome this problem, public universities could develop an incentive system based on individualised plans negotiated between staff and deans. If agreed targets are achieved, additional internal funding or improved resources can be provided, permitting greater flexibility.** Universities could also make more flexible use of workloads, allocation of time and resources for research that are agreed between staff and managers, including performance targets, backed up with appropriate annual appraisal and rewards. Other incentives include supportive conditions for teaching, opportunities for individual development through mobility, academic freedom, and additional responsibilities. Transforming the system would also require greater flexibility in terminating employment contracts of staff members in tenure-like contracts.

Developing a better-functioning tenure system. Across the world, HEIs and governments – if the academic career system is determined at

governmental level – have developed well-functioning tenure track-type career systems which are characterised by three key elements: (i) an entry position which new talented individuals can apply for in order to access the career as a researcher and/or teacher; (ii) career pathways; and (iii) 'sticks and carrots' to enhance and ensure quality performance. The system functions in a supportive way so that the staff can develop and their potential will be fully utilised. The interviews confirmed the previous analysis (Klincewicz & Marczewska 2017) that the current tenure-like system is underperforming not only in terms of access to the system but also in terms of appropriate evaluation and assessment of the work or output of the individuals – whether teaching, research or knowledge exchange. See the Learning Model 4.3.5.3. on the tenure track and EPFL for a well-developed tenure-track system in a research-intensive technological university. The key lesson for Poland is to develop a career system that identifies and underpins excellence at an early stage and does not limit quality performance and scientific achievements.

Bridging the gender gap. Despite commendable progress made in increasing women's participation in the HE and science system, there is a clear gender bias in academic titles and positions as well as research grants. The gap between men and women widens with rank. In 2015, the share of habilitation degrees awarded to women was 44 % and the share of professor's titles was 28 % (down from 33.7 % in the previous year)[49]. In 2013, women held 48.3 % of PhD titles, 33.6 % of the Dr hab. titles and only 22.6 % of the professor titles (EC 2016c). The share of women is highest among the lowest-ranked and lowest-paid positions[50]. Research teams lead by male professors have a far better chance of obtaining research grants in all disciplines (apart from engineering), including humanities and social sciences: teams led by male professors have a 27.8 % success rate compared to 22.5 % for teams led by female professors (Mlodozeniec & Knapinska, 2013). Furthermore, the most recent study of social sciences (Warczok & Zarycki, 2016), based on data collected in 2015, shows a relatively balanced gender distribution at low academic levels[51], but an increasing bias at higher academic levels[52]. Female doctoral candidates and female scholars remain in a disadvantaged position in recruitment to academic positions, access to research funding, and promotion to higher academic positions. Since the employment legislation for academic staff also grants more job security to senior categories,

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[49] http://stat.gov.pl/obszary-tematyczne/edukacja/edukacja/szkoly-wyzsze-i-ich-finanse-w-2015-r-,2,12.html

[50] According to Mlodozeniec & Knapinska (2013), 54 % of research assistants ("asystent") are women, 44 % among assistant professors ("adiunkt"), 32 % among lecturers ("docent"), and 27 % among associate/full professors ("profesor").

[51] The most recent social sciences study, which was conducted by Warczok & Zarycki (2016), shows that gender is relatively well balanced at low academic levels (in case of PhDs: 40 % of women in political science, 51 % in sociology, 43 % in economics, 68 % in psychology, 39 % in law), but it becomes biased at higher academic levels (in case of professor titles: 12 % of women in political science, 26 % in sociology, 23 % in economics, 42 % in psychology, 15 % in law). Their data are the most recent, having been collected in 2015.

[52] 12 % of professor titles in political science, 26 % in sociology, 23 % in economics, 42 % in psychology and 15 % in law.

Polish women are not only under-represented in prestigious and influential positions, but are also more exposed to precarious employment conditions.

Part of the reason for the under-representation of women is the lack of national-level regulations to improve equal opportunities in HE careers or policy measures to reduce or prevent gender differences in academic ranks[53]. A way out of this situation is to introduce national policy measures or initiatives that pursue gender balance among academic staff, including the higher ranks, preventing and limiting gender differences, while simultaneously pursuing active measures, especially at institutional level, to make optimal use of the pool of talent that female students and staff constitute. There are many policy examples that can provide Poland with inspiration as more than half the EU countries have introduced general or specific legislation on equal opportunities in HE. For example, since 2000, Switzerland has had policies and initiatives in place to reduce gender inequality which is seen as a weakness in the HE and science system (see Box 4.5).

Box 4.5: National policies for gender balance among academic staff in Europe

Ensuring that selection committees comprise both genders

- In France, at least 40 % of the members of any selection committee must be women. In disciplines with greater gender disparity, the least-represented gender can be favoured.

- Iceland has minimum requirements for gender representation on selection committees. An equality rights committee oversees all issues related to gender equality.

Establishing minimum quotas for each gender

- In Austria, all staff categories and university boards should have an equal share of men and women. Women are recruited when they have the same qualifications as men. Each institution must have an equal opportunity board to deal with complaints.

- In Germany, the research organisations in the Pact for Research and Innovation have set target quotas for recruiting female researchers. The share for each staff category is based on the proportion of women at the career level immediately below. The long-term goal is an equal share of women and men at all career levels. Institutions report on progress to the German Research Foundation.

- In Luxembourg, targets have been set for the National Research Fund. The fair balance in gender representation, including executive positions, is part of the performance contract between the University of Luxembourg and the government.

Incentivising gender balance in academia without prescriptive targets

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53 Provisions in the Polish Labour Code prohibit discrimination of women in labour market access, including protection for pregnant women and those on maternity leave.

- In the UK, the Athena SWAN Charter was established in 2005 by the Equality Challenge Unit, a charity funded by the Funding Councils of England, Scotland and Wales and Universities UK, and through direct subscription from HEIs in England and Northern Ireland, to encourage and recognise institutional commitment in advancing the careers of women. The Scottish Government has reiterated its priority to address the under-representation of women on governing boards of colleges and universities and at senior academic levels (2015/16 and 2016/17).

- In Ireland, the Higher Education Authority (HEA) has carried out a system-wide review of gender profiles and gender equality policies in HEIs with the help of an expert group[54]. Recommendations include: quotas for staff categories based on the share of genders at the career level immediately below; the use of the Athena SWAN institutional award; and a 40 % minimum representation of either gender in the bodies taking decisions on resource allocation, appointments and promotions. The HEA publishes annual data on the gender breakdown of academic staff. The Irish Research Council's Gender Strategy and Action Plan 2013-2020 supports gender equality in research careers, and encourages the integration of gender analysis in researchers' work and by gender-proofing the policies and procedures of the council itself.

- Sweden has an initiative for 2016-2019 aimed at mainstreaming gender equality in HEIs. This initiative, which is backed with funding (SEK 5 million) by the Swedish Secretariat for Gender Research, helps institutions develop and implement gender mainstream plans.

- The Swiss Federal Ministry of Education has been running a federal gender-based equal opportunity programme since 2000, with the 10 Swiss cantonal universities, and each institution has an equality action plan as a consequence. Moreover, there is specific monitoring in this area, with the availability of gender-segregated data.

Developing concrete measures in the general legislation on equal opportunities

- In Finland, each organisation with more than 30 people must have a gender equality plan which is updated annually in cooperation with staff representatives. The plan includes: 1) an assessment of the gender equality in the organisation; 2) planned measures for promoting gender equality; and 3) an evaluation of the implementation and success of the measures developed earlier.

Source: Eurydice (2017), Modernisation of Higher Education. Academic Staff 2017; https://webgate.ec.europa.eu/fpfis/mwikis/eurydice/index.php/Publications:Modernisation_of_Higher_Education_in_Europe:_Academic_Staff_–_2017

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[54] HEA_review of Gender equality in Irish Higher Education: http://www.hea.ie/sites/default/files/hea_review_of_gender_equality_in_irish_higher_education.pdf [accessed 16 June 2017].

4.3.5 Recommendations on human resources

The quality of the HE and science system is determined by the quality of its human resources. This resource can be stimulated by providing opportunities for the best talent to develop. Poland's doctoral training and academic career system require a radical change and strong reforms, rather than adjustments and piecemeal improvements. To attract and nurture talent, ensure it is important to provide attractive career prospects, and make sure that staff can fully utilise their potential and that quality is maintained throughout both the system and the individual's career.

The panel suggests that the following measures are taken to develop the career system in the HE and science system:

Reform doctoral training.

- **Reform doctoral training to ensure state-of-the-art research competences that need to be generated in larger numbers**. Stimulation and training of Poland's best talent must be articulated with similar activities in advanced economies and have a broad focus on the wider labour market. This is best achieved by developing robust indicators to monitor outcomes such as doctoral employment rates and return on investment for PhDs. There is a need to tighten entry to doctoral programmes, consolidate their duration and develop structured programmes that address both disciplinary knowledge and transversal skills. Doctoral training could be enhanced by financing doctoral fellowships on a competitive basis and continuing to develop newly established industrial doctorates (implementation doctorates). The key step would be to organise doctoral training in institutionalised (national) programmes or doctoral schools. Poland could consider concentrating its doctoral training at the strongest universities which would accept and be held accountable to nationwide responsibilities (for example, PhD training in key priority areas) and admit talented students from all over Poland and abroad with a minimum target of 25 % of foreigners.

Reform recruitment and career progress structures.

- **Consider abolishing habilitation in its current** form in line with the reasons presented by the Law 2.0 reform proposals (Kwiek et al. 2017; Radwan et al. 2017). Ensure that a PhD will mark the end of academic studies and provide the sole 'eligibility licence' for employment at research and teaching positions within academia and being entrusted to do research. If the authorities retain habilitation as a title, it should not affect any opportunity to apply for a position or research funding, conduct independent research, or set up a research group.

- **Ensure that career progress is based on the evaluation of an individual's achievements, applying transparent and quality-oriented assessment criteria.** It is of key importance to the Polish academic system's progress to move away from the culture of 'inbreeding' when recruiting and promoting academic staff. Except for entry positions to academia positions for doctoral candidates, and first position after the PhD (filled on the basis of the candidate's potential), academic career progress should be based on the quality of work and output, not that individual's position in the department or faculty. Currently, the Polish academic career structure does not pay sufficient attention to individuals' scientific and other achievements and output. This has led to the promotion of individuals who have secured a position in the system, but with limited attention to their scientific achievements. Camaraderie, loyalty to superiors and adaption to established paths (and 'truths') of research serve as a basis for promotion and career progress. To enhance mobility, consider establishing a rule that HEIs are not allowed to recruit their own graduates to postdoc positions and the entry position in a tenure-track system.

- **Change the structure of academic positions based on the proposal by Radwan et al. (2017) which is in line with international practice** (and only marginally different from the structure proposed by Kwiek et al.) to develop a robust tenure-track system. There may be teaching positions in addition to research-oriented positions, but combination of research and teaching should be the norm for most positions, although the balance may differ. Any separation between research and teaching positions will depend on the types of HEIs Poland has in the future. This will also affect how knowledge exchange and transfer are taken into consideration.

- **Revise the academic recruitment/career progress system to reflect a broader range of research outputs, teaching excellence impact and engagement in order to incentivise a faculty to engage in teaching, research and knowledge exchange** that meets the needs of Poland's society and economy and is in line with the institution's mission. For example, encourage recruiting, hiring and reward systems to include third-mission activities in a mode relevant for the institutional type, including a regional and local development agenda. Ensure that recruitment and career progress takes into account entrepreneurial attitudes and experience. For rewarding teaching excellence, consider the Norwegian experience[55].

Foster industry-academia interaction.

- **Enhance industry-academia interaction by facilitating sectoral mobility for doctoral candidates and HE staff.** Continue to develop industrial PhDs (implementation doctorates) in order to equip PhD candidates with both in-depth expertise in a scientific field and an understanding of needs and application in industry or the business sector at large. Ensure that business-industry/public professionals who teach in HEIs are granted appropriate compensation, advancement opportunities and status. Make sure that academic positions are made attractive for industrial experts, and allow for them to spend part of their working time at an HEI alongside their private company employment. A flexible position for the recruitment of industrial experts to academia has been institutionalised in Sweden, and may serve as inspiration. Several universities in the UK and USA have established Professors of Practice (PoP) positions, for example, University of Warwick and Cornell University. PoPs are successful senior

[55] Norway's pedagogical competence and merit systems: https://www.regjeringen.no/en/topics/education/higher-education/innsikt/kvalitet-i-hoyereutdanning/id2008162/

business and industry practitioners who contribute to teaching, interact with faculty at an applied level and help facilitate research impact. See the Learning Model on 5.3.5.4. Professors of Practice (PoP) in Cornell University.

Enhance professional development of teaching and administrative staff.

- **Professionalise and modernise the HE administration by offering high-quality continuing professional development opportunities for administrative staff** to develop and update their task-related and transversal skills and to facilitate the take-up of new responsibilities.

- **Further invest in the continuing professional development of academic staff to enhance the quality of teaching.** Encourage institutions to develop incentive systems that motivate academic staff to improve their pedagogical skills, teaching innovation, collaboration between teachers, and the use of new technologies throughout their career. Poland could find inspiration from the large-scale system-wide CPD programmes/actions such as the HEA in the UK and the National Forum for the Enhancement of Teaching and Learning in Higher Education in Ireland. The HEA has established professional standards in teaching and learning aligned with the Quality Code, which is the overall reference framework for HE quality assurance. These standards support HEIs in developing their own training provision, including CPD provision. The Staff and Educational Development Association (SEDA) has put in place an accreditation scheme for professional development programmes and a system of qualifications (awards) validating these programmes. Ireland's National Forum in HE has developed a national professional development framework which provides guidance for planning, developing and engaging in professional development activities. There are also several nationally funded collaborative projects targeting various skills among academics, including digital literacy and foreign language skills.

Bridge the gender gap to make full use of Poland's human capital.

- **Remove gender-related barriers and implement training on gender issues.** In Poland and across Europe, women remain under-represented among academic staff, especially in higher ranks. To enhance gender equality in academia and research careers, a 40 % minimum representation of either gender is required in the bodies taking decisions on resource allocation, appointments and promotions in HEIs and PROs as well as funding agencies. Encourage a more balanced distribution of projects and funding allocation among male and female researchers, across all fields. Integrate gender analysis in R&I content to enhance the scientific quality and societal relevance of knowledge, technology and innovation. Enhance the attractiveness of the career re-start in terms of funding, family allowances and duration, given that a career re-starter often requires more than two years to catch up with peers. Provide incentives in the form of eligible funding for promoting gender aspects in scientific sectors.

4.3.6 Learning models

4.3.6.1 Enhancing doctoral training in Denmark and Aarhus University

In 2006, Denmark set a goal in the Globalisation Agreement to increase the intake of PhD candidates, particularly in medical and health sciences, natural sciences, and engineering and technology fields. The agreement was concluded between a broad majority comprising the Liberal Party, Conservative Party, Social Democratic Party, Danish People's Party and the Social-Liberal Party in order to increase investments in research with the aim of enhancing growth and innovation capacity. As part of the investments, universities were required to raise the annual intake of PhD candidates to 2400 students, with the main focus on the key fields listed above. The increased intake was partly designed to create a recruitment pool of highly educated researchers for both the private and public sector.

In the period 2003-2010, the intake of PhD candidates doubled from 1200 to 2400. In 2015, 2300 new PhD candidates were registered and 2119 completed their PhD programme. The share of international PhD candidates rose by 19 % from 2003 to 2014. Five years after graduation, 41 % of international PhD candidates from the 2009 graduation cohort remain in Denmark; 75 % of the responding international assessors of Danish PhD theses deem the quality of the PhD theses to be good or very good compared to international standards; and 19 out of 20 PhD graduates are employed (OECD rank no. 5). With 37 % finding employment in the private sector, Denmark is ranked first among OECD countries. The financial return on a PhD programme is between DKK 400 000 and DKK 700 000 after tax and benefits over the course of a working life, which corresponds to a return of between 3 % and 4 %. Based on earned income, the gains roughly equal the costs, but PhD candidates give additional value through research and knowledge.

At Aarhus University, each of the four fields – health, science and technology, arts, and business and social science – developed a dedicated graduate school to provide an effective framework for doctoral training. Each doctoral school ensures that a PhD candidate benefits from a strong scientific environment, including high-quality supervision by dedicated academics and involvement in cutting-edge research. A full professorship does not automatically confer on an academic staff member the right to supervise doctoral candidates. The doctoral schools are established in line with the Salzburg Principles launched by the European University Association and provide structured pedagogical programmes. Each PhD student must deliver a predetermined period of teaching and engage in international mobility by presenting papers at conferences, attending seminars, offering guest lectures outside of Denmark, etc.

Results of the transformation of graduate training have been positive. Aarhus University doubled the number of doctoral candidates between 2007 and 2017, from about 1000 to 2000. At the end of 2015, the total reached 1845 (arts and humanities 267, science and technology 673, health sciences 665, Aarhus School of Business and social sciences 240). Of these, 39 are industrial PhD candidates, and many more are co-funded by industries, foundations, foreign sources, etc. The average time to completion is 3.2 years (ranging from 3.1 years in science and technology to 3.5 years in arts and humanities). Graduation age varies between 30 in science and technology to 35 in health and humanities. The average employment rate six months after graduation is 94 % but higher for science, technology, health science, economics and industrial PhD graduates.

All the university's academic areas have experienced growth, with a particular focus on health, natural and technical sciences in line with labour-market demand for high-level competencies. Despite the expansion, the university has maintained high-quality standards, for instance, by requiring each student to develop a study plan which is supervised via progress reports twice a year, and ensuring that the final dissertation is subject to international review. The growth in doctoral student numbers has been matched by the attraction of international talent. Currently, one in four PhD candidates is of non-Danish origin; in some fields, over 50 % of doctoral candidates come from abroad.

A key part of this success lies in monitoring the outcome of talent development. Apart from the structured monitoring and supervision of the research and educational programme, Aarhus University conducts an annual employment survey of its doctoral candidates. This measures the extent to which doctoral candidates find relevant employment, and enquires whether doctoral candidates find employment they consider relevant to their studies.

Sources: Aarhus University; Uddannelses- og forskningsministeriet (2017). Ph.d.-uddannelsens kvalitet og relevans. Sammenskrivning af hovedresultater; English summary

4.3.6.2 Denmark's industrial PhD programme

The Danish Innovation Fund (innovationsfonden.dk/en) runs an industrial researcher programme, which encompasses industrial PhDs and postdocs. The industrial PhD programme (established in 1971) develops research talent into industrial researchers. The industrial PhD candidate is employed by a Danish division of a company and enrolled at a university, with a supervisor from both parties. Candidates typically spend 50 % of their time in a company and 50 % at a university, but the share varies according to the project and throughout the project. Annually, about 100 PhD candidates are receive support. In addition, since 2010, 10 stipends have been allocated to the public-sector scheme (collaboration with municipalities, vocational institutions and nursing schools, etc.). Because of the low share (4 %) of industrial PhDs in Danish PhDs as a whole, the programme funds all eligible projects (60 % funding rate). The Innovation Fund brokers relationships, reviews proposals and encourages communication between the parties.

To join the programme, a firm and a university must submit a joint application to the Innovation Fund. Applications are evaluated based on their commercial relevance and scientific quality. The firm, university, supervisors and the PhD candidate must all meet the programme requirements: for example, the firm must have a division based in Denmark, offer facilities and financial support for the entire project duration, and assign a supervisor and co-supervisor for the project. Companies can collaborate on a single industrial PhD project. The PhD candidate is required to participate in postgraduate business studies in addition to pursuing traditional research training and conducting a research project. The final thesis is evaluated according to criteria equivalent to a traditional PhD thesis.

Most participating firms are research-driven, regardless of size. Small companies are often university spin-offs. In particular, the public-sector PhD programme targets non-research-intensive public institutions. About 60 % of the partner companies have over 249 staff (2013).

The annual budget of EUR 16 million, with each stipend at EUR 134 000 (DKK 1 million) has remained stable over the last five years. The budget for public sector PhD projects is EUR 1.34 million (DKK 10 million in 2016). The firm pays the candidate's salary and receives a monthly salary subsidy from the Innovation Fund equivalent to EUR 2300 for three years (the grant is limited to 50 % of gross salary expenses). The university receives a subsidy for supervision, equipment and additional expenses for the candidate's education (EUR 33 800 for projects in social sciences and the humanities and EUR 48 300 for projects in natural, technical, agricultural, veterinary and health sciences).

Around 75-80 % of PhD candidates are in natural sciences, but applications in humanities and social sciences are growing. 90 % of industrial PhD candidates are master's degree holders who wish to continue to PhD level and work with industry, while others have significant work experience.

The programme has had positive results: 80 % of industrial PhD holders find their first job in the private sector (compared with 30 % of non-industrial PhD holders). Salary levels are comparable to conventional PhDs. In 2004-2009, the employment rate was very high (more than 98 %) and slightly higher than for conventional PhDs. Companies benefit from: i) access to academic research knowledge; ii) higher growth rates; iii) increased patenting activity; and iv) the ability to pre-screen hires and positive employment development.

Source: ICF (2017) European Industrial Doctorates - towards increased employability and innovation. Final report, submitted to DG EAC on 3 February 2017

4.3.6.3 The tenure track and EPFL

First developed in the United States in 1940s (see Finkin et al. 2007), tenure-track systems have become the established norm for the career structure of academic positions around the world. In spite of many differences across universities and countries, the basic features of the system are:

After a one-to-three-year postdoc phase (or longer in some disciplines or countries), an individual can apply for a competitive time-limited (five to eight years) position, equivalent to 'assistant professor' in the US system. Candidates are selected in competition with other applicants, based on their academic merits. A successful candidate has access to research resources sufficient to quickly initiate his/her own academic research, usually for one to three years of guaranteed employment. At the end of this period, in order to certify that the individual has initiated research and teaching in accordance with expectations, his/her achievements are evaluated and the position may be extended for the full period. In addition to a possible second mid-term review, there is a comprehensive evaluation shortly before the full period ends (after four to seven years). The purpose of the final evaluation is to determine whether or not the individual should be offered a permanent (tenured) position, based on the achievements and outcome during the assistant professor period. External evaluators are included in the evaluation committee. The evaluation focuses on research-related results, although teaching results are often included as well, depending on the nature of the position sought. If the individual passes this final evaluation, she/he is offered a permanent position (often equivalent to ‘associate professor’ in the US system). After a number of years and a successful track record based on a transparent set of quality standards, the individual is entitled to a position of ‘full professor’ or similar.

The École polytechnique fédérale de Lausanne (EPFL) in Switzerland, ranked 30 in the Times Higher Education World University Ranking in 2017, introduced the tenure-track system in 2000. The decision attracted a degree of tension among staff during the first years, before the structure found its place. EPFL carefully recruits talents to the first entry position, almost entirely selecting candidates aged 28-35 who have completed a postdoc period abroad. The tenure-track position is for six years. About 75 % of these researchers pass the final evaluation and are offered permanent positions[56]. In the USA, lower rates (40-50 %) are usually applied to avoid the risk of inbreeding. The remaining share receives an extension period of up to two years, during which they can apply for positions elsewhere before their contract with EPFL ends. A similar tenure-track system has been developed in ETH Zürich, which is ranked no. 9 in the Times HE World University Ranking and 19 in ARWU Academic Ranking of World Universities (Melin and Högberg 2006).

4.3.6.4 Professors of Practice (PoP) in Cornell University’s College of Engineering

In 2015, the College of Engineering faculty introduced the PoP title to recruit outstanding faculty members with significant, high-level experience in industry or equivalent. The title is reserved for individuals whose experiences in industry or other non-academic organisations complement the college’s tenure-track and non-tenure-track faculty. The purpose is to be able to recruit and retain the best possible non-tenure-track faculty and to maximise their contributions to the college. PoPs are not expected to contribute to research at the level expected of tenure-track faculty members (although where appropriate they will be encouraged to do so). PoPs are expected to enrich the student experience by bringing industry experiences into the classroom, advising on career decisions, student entrepreneurs, projects, or supporting institutional building, for example, developing institutes. They also contribute to external visibility and impact. The position was created in response to similar positions in competing institutions as well as increasing opportunities to bring faculty members with external experience to Ithaca and the Cornell NYC Tech campus.

- Terms of appointment: all PoPs are non-tenure track and hold three-to-five-year renewable appointments. They have all the rights and responsibilities of senior lecturers plus the right to vote on appointments to PoPs. Movement between PoPs and tenure-track appointments are possible in exceptional cases determined by the dean and with the approval of the faculty. The number of PoP faculties cannot exceed 25 % of the number of tenure-track faculties in the college. The PoP title does not affect the number of tenure-track or other non-tenure-track faculties in the college.

[56] Source: Interview with a representative at vice-rector level, 2006. The panel has found no information as to whether this figure is still valid.

- Selection: PoPs are based on national searches and internal appointments, focused on senior and highly qualified candidates. Candidates must have significant leadership experience and hold a senior technical, research or management position in industry or other equivalent non-academic organisation plus a bachelor's degree in engineering or a related scientific or technical field. A master's or PhD is preferred. Advanced degrees may be in business or related fields

- Appointments and reappointments: for each PoP appointment, there must be a specific job description and evaluation criteria which will be used in selecting the candidate and for ongoing evaluations, including annual evaluations for the salary improvement programme. There are two types of PoPs: (i) those appointed by one of the departments, identified through a search process that mirrors the process used for tenure-track faculty; (ii) for college-wide PoP appointments, a college ad hoc committee composed of tenure-track and existing PoP and/or senior lecturer faculty (mainly tenure-track) is appointed by the dean. Reappointments are based on performance in relation to the pre-set evaluation criteria established for the position. The director or chair, or associate dean, reviews the performance annually with the individual.

Source: Cornell university. Faculty of Engineering; http://theuniversityfaculty.cornell.edu/faculty-senate/current2-draft/resolution-106-professor-of-practice-title-college-of-engineering/

4.4 Quality assurance and evaluation

4.4.1 Poland's quality assurance and evaluation actors

Currently, the Polish system of quality assurance (QA) and evaluation in HE and research is nationally driven and relies on the actions of state authorities. It is insufficiently aligned with international scientific standards and lacks transparency due to over-regulation and excessively detailed procedures.

Five organisations are charged with evaluating the quality of the different aspects of the HE and science system or funding applications in Poland:

Research quality

- **The Committee for the Evaluation of Scientific Units (KEJN) categorises around 900 research units, with about 100 000 academics, into four groups: A+, A, B and C.** Most units fall under category B (56 %), while only 4 % attain the A+ category (see Figure 23). The evaluation is based on four criteria: publications, capacity, third-party income and 10 'highlights' submitted by the unit. Publications (national and international) determine 60 to 80 % of a unit's total research performance. Limited consideration is given to citation impact, especially international citation impact[57]. Reform proposals by the three teams advocate reforms to evaluation system (see Chapter 1.2). Radwan et al. (2017) proposes the establishment of an independent National Council for Scientific Excellence (NRDN) with broad representation (academia, business, government, etc.) to act as an advisory body, and to collect data in a standardised way. The NRDN would be the MNiSW's key politically neutral advisory body for designing and updating a strategy for developing Polish science. As regards the quality assessment system, the NRDN would verify the profiles (values) of reference units for individual scientific categories, participate in audits of A category scientific units, and recommend modifications to the quality assessment system.

Quality of competitive funding applications in RDI

- **Strictly speaking, the NCN and NCBiR are not part of the quality assurance architecture but play an important role in conducting *ex-ante* evaluations of projects in the competitive procedure**. The NCN is a science-driven, politically neutral and independent institution which funds high-quality fundamental research on a competitive base. It is widely accepted among Polish researchers as a quality-oriented and effective institution. The NCBiR aims at supporting the creation of innovative solutions and technologies that foster a competitive Polish economy, thereby also strengthening collaboration between academia and business. By defining the selection criteria for funding, both funding agencies have a high impact on the quality assurance of research in Poland.

Quality of study programmes

- **The Polish Accreditation Committee (PKA) evaluates study programmes at the bachelor's and master's level**. The evaluation criteria comprise a long list of items and themes, ranging from programme design, the qualification of teachers and the infrastructure used to educational standards, internationalisation and assessment of learning outcomes. While this list is appropriate, the emphasis of the PKA evaluation is on study programmes, rather than the quality assurance systems of HEIs. The PKA members (80-90) are recruited nationally and appointed by the minister responsible for higher education and science.

Quality scientific degrees and titles

- **The Degrees and Titles Commission works to maintain the standards of scientific promotions.** In operation since 1951, it is a central state body when a ruling deprived the universities of the right to award the highest scientific degrees and titles (Dr.habil, professor). Radvan et al. (2016 p. 268) suggest the abolition of this Commission and postulate that universities in categories A and B should be entitled to confer doctoral degrees autonomously, in contrast to the other two proposals by Izdebski et al. 2017 and Kwiek et al. 2017 which would maintain the Commission's current role.

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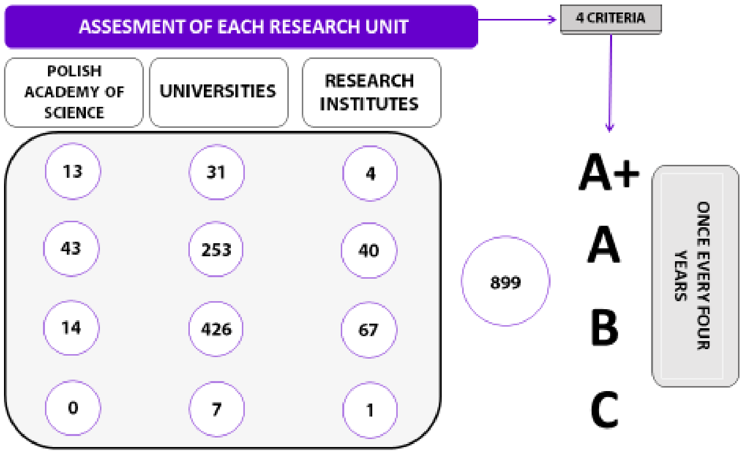
[57] Interviews also confirmed the impression that the A+ status does not guarantee international quality.

Figure 23: Evaluation of scientific units



4.4.2 Challenges in the quality assurance and evaluation system

There is a general need to reorient and restructure the quality and evaluation systems and to increase their transparency:

- The current research evaluation system is not fit for purpose and needs to be transformed from a bureaucratic exercise into a system that incentivises high-quality research performance, rather than simply facilitating funding distribution. Half of the public research funding is distributed on the basis of the scientific units' evaluation; the mechanical link between the evaluation and funding allocation raises a number of concerns, as noted in Chapter 4.2.1. The evaluation is based on a complicated count of publications, somehow weighted by the impact of scientific journals in which the contributions were published – but not on their citation impacts – as well as awarded titles (PhD degrees, awarded professor titles). Accordingly, during the period 2009-2012, KEJN evaluated over 184 000 publications and 182 000 other research outcomes (Kulczycki et al. 2017). The underlying calculations are facilitated by a sophisticated parametrisation system which, in its current state, does not provide adequate incentives for research excellence since it does not sufficiently account for international relevance or citation impact (see the annex to this report for more details on the SEDN system). There are concerns that the system has led to 'gaming', given that the number of publications in international journals with impact factor tripled within five years[58]. The MNiSW plans to scale down the volume of government regulation, reducing the number of grading criteria from four to

[58] Interviews highlighted that some institutions may have paid for submissions in journals with low or average impact factors Part of the challenge is the scope of the eligible Polish scientific journals (2212 in December 2015), each awarded with a number of points (between two and 15) in the ministerial assessment based on predefined criteria. HEIs aspire to publish their own journals, and scientists have too many 'easy' publishing opportunities which undermine quality goals. Furthermore, most domestic journals publish in the local language and would not benefit from input from foreign peers, even though they may list researchers from other countries as members of journals' scientific boards.

three[59] (and significantly reducing the sub-criteria) while moving the focus from scientific units to field-specific evaluations and introducing a new B+ grade. The resulting new five-scale categorisation is expected to indicate a clear point of departure for HE landscape reform as it facilitates the division of HEIs into three groups, funding allocations to different types of institutions, and authorisation of degree-awarding rights, including doctoral degrees and habilitation[60].

- **There is a need to move away from the focus on control of HEIs to incentivising a quality culture among institutions.** Quality challenges in education and teaching relate to both institutional and individual aspects. Currently, study programme evaluations are perceived as an obligation or punishment rather than support for improving performance and quality, whereas institutional evaluations are lacking in the system design. At the individual level, the current systems focus on successive control points of quality (promoting diplomas) which leads to an over-conservative system and may hinder research performance and innovation. See Chapter 4 on human resources for a more detailed discussion on these issues.

- **There is a need to improve the openness and transparency of the quality assurance and evaluation system.** Currently, reviews of research-funding applications and applications for academic promotion are not always open. There appears to be strong resistance from inside the system to open up and make documents publicly available. International transparency and quality of research is hampered by using only the Polish language in doctoral theses, habilitation process and in many journals. The Degrees and Titles Committee publishes both the applications and reviews online, but only uses the Polish language. These systems have not taken advantage of international peer reviews.

4.4.3 Recommendations on quality assurance and evaluations

Develop a lean, effective and transparent system of quality assurance and evaluation system for HE and science, by: (i) simplifying the quality assurance system architecture; (ii) ensuring alignment with international standards in science and making the system less state-driven; and (iii) increasing the transparency and openness of the systems.

Regular external evaluation of publicly funded support programmes and institutions – with international participation to avoid favouritism and to ensure international relevance – should cover all parts of the HE and science and innovation system. Evaluation should be firmly embedded in the policy cycle so that results will feed back into subsequent rounds of support and policy design.

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[59] Current criteria: publications, capacity, third-party income and 10 'highlights' submitted by the unit for peer review; planned criteria: international publications, external funding and social impact based on external peer review.

[60] In the new system, teaching universities would not have the right to award doctoral degrees, while in the case of middle-range institutions, this would depend on the grade. Doctoral habilitation would only be possible for A+ and A institutions.

The panel suggests the following measures:

Reform the research evaluation system.

- **Develop a research-evaluation system based on three key pillars: (i) assessment of research performance based on publications; (ii) careful assessment of impact of research; and (iii) regular international peer reviews, covering all fields and relevant institutions.** Move away from the mechanical count of hundreds of thousands of outputs towards evaluating quality and impact, using the UK experience with research assessments as inspiration. Currently, the Polish research evaluation system focuses on counting publications, including local publications with limited impact. In the new system, impacts can be assessed by bibliographic database providers, such as Thomson Reuters or Elsevier and ISI for highly cited researchers.

- **Eliminate the extra bonus for the number of PhD candidates in universities' statutory funding formula (for teaching).** Instead, start funding high-quality PhD programmes in universities through competitive grants from the NCN, as the DFG in Germany does, for example. See also Chapters on Doctoral training and Funding.

- **Undertake an institutional review of the current work and future role of the Committee for Evaluation of Scientific Research Institutions (KEJN).**

- **Consider two options: (i) Link the evaluation by KEJN to the public funding of institutions, as is the case with the 'Research Excellence Framework'** in the UK (previously: Research Assessment Exercise), and ensure that KEJN assessments foster frontier research and innovations, **or (ii) finance the excellence layers within institutions on the basis of a competitive bid**, as in Germany, nominating NCN (DFG in Germany) to prepare decisions regarding designation of the label of excellence and the related additional funding to institutions. Transferring this task to the NCN would simplify the institutional structure of Poland´s quality assurance system. This would require strengthening the NCN, to focus on high-quality research which prepares scholars to reach out to secure European research funds.

- **Abolish the link between research-funding allocation and the SEDN system which is currently the basis of the Comprehensive Evaluation of Scientific Units.** Evaluate the costs and benefits of maintaining the SEDN system and, on the basis of this evaluation, consider whether it is useful to transform the SEDN system into an instrument for government (and institutions) to monitor and inform policy development, which currently seems to be underdeveloped in the Polish HE and science system. Ensure that the diverse set of 'scientific events' would take scientific impact into consideration. The monitoring tool could be coordinated by the proposed National Council for Scientific Excellence (NRDN) (see Radwan et al.). This politically neutral advisory body would have a broad representation (academia, business, government, etc.), would be the MNSRiW's key advisory body for designing and updating the strategy for developing Polish science, and would collect data in a standardised way.

Move away from study programme evaluations to institutional assessments.

- **Distinguish the quality assurance for improvement purposes from the quality assurance for accreditation.** The current system combines these two elements with the result that HEIs neither seek nor receive constructive feedback for quality improvements.

- **Increase the autonomy of the PKA by entitling it to propose institutional assessments** (and not only programme evaluations).

- In line with the EHEA, refocus the PKA's work on assessing the quality of institutional quality assurance systems, looking at a sample of individual study programmes within an institution. If the institutional quality assurance system is not satisfactory, the PKA may turn to programme evaluation again. To ensure international orientation and competitiveness, award some HEIs, for example, the research-intensive universities, the right to gain accreditation from an agency abroad, registered in the European Quality Assurance Register for Higher Education (EQAR). For greater labour-market relevance, ensure that the PKA has labour-market representatives who seek advice from the employers where appropriate. See the Learning Model 5.4.4.1. on HE quality assurance and accreditation in the Netherlands in relation to stimulating a quality culture.

Consider phasing out the Degrees and Titles Commission

- Consider phasing out, and ultimately abolishing, the Degrees and Titles Commission and transferring some of its current responsibilities to the PKA and HEIs. Besides funding high-quality doctoral programmes through grants from the NCN, the PKA could take up evaluating the quality of doctoral programmes when assessing a university's institutional quality assurance system. Another option would be to allocate this task to the organisation that will be in charge of evaluating research quality. As regards awarding the title of professor, it has become an international standard to transfer this right to the HEI concerned. Transferring this responsibility to the HEIs would facilitate capacity-building and institutional profiling.

4.4.4 Learning model

4.4.4.1 HE quality assurance and accreditation in the Netherlands in relation to stimulating a quality culture

When quality assurance was introduced in Dutch HE in the 1980s, its coordination was put in the hands of the collective HEIs in order to create ownership of the instrument among the academic community and thus to focus it on quality improvement as much as on accountability. Early results included 'low hanging fruit', such as starting the internal conversation on coherence of study programmes and growing awareness of didactical questions. However, peer-review discussions were never as equal and free as intended, given the shadow of accountability. Yet, to a large extent, accountability was not achieved as peer reports were too long, convoluted and balanced to convey meaning to 'end-users', such as prospective students. This situation prevailed both in the university and in the UAS (polytechnics) sectors, as an early pilot with institutional evaluation in the UAS sector failed due to the fact that these institutions have largely merged very recently and have yet to be thoroughly integrated. Another reason for failure included the lack of experience in internal quality assurance.

At the time of the Bologna Declaration (1999), decision-makers were ready for a new approach to quality assurance, and programme accreditation seemed to fit the bill of creating the desired transparency for end-users both nationally and in the developing European Higher Education Area. Accreditation of a study programme entails the degree being recognised (bachelor or master's); word chanegfunding from the government (only in publicly funded HEIs); and students enrolled in the programme being eligible for student loans/grants (also in privately funded institutions).

Accountability had priority over the development of a quality culture in the early 2000s. After completing accreditation of all bachelor and master programmes in public and private HE providers in both the university and UAS sectors, attention shifted from assuring threshold level quality to: (i) awarding graded accreditation for above-threshold programmes; and (ii) making efficiency gains in the accreditation procedure by auditing institutional quality management once across the whole institution rather than repeating it for each programme. At the same time, the institutional audits introduced in 2011 were intended to stimulate the maintenance and development of a quality culture in the HEIs: enough experience should have been built up since before 1990. Although the efficiency gains of the 'lighter-touch' programme accreditation remained disputed, all multi-programme institutions endeavoured to gain a positive institutional audit as it signalled their having comprehensive and effective internal quality management which in turn implied (the beginnings of) a positive quality culture. To date, 35 institutions have achieved a positive institutional audit.

Source: Don Westerheijden, CHEPS

5 THIRD MISSION AND LINKS BETWEEN HIGHER EDUCATION AND INDUSTRY AND SOCIETY

5.1 Third mission

There is a growing recognition in Poland that higher education institutions (HEI) form a critical part of the innovation system infrastructure; at the intersection of research, education and innovation, they provide access to local, national and global networks of knowledge, as well as infrastructure and talent for innovators. **Despite the changes following the Science and Higher Education Reform of 2010-2011, the HEIs' third mission and their engagement with society and industry remain challenges: action is limited to a narrow range of activities, with emphasis on research publications, graduating students and mostly linear models of knowledge transfer. The related policies in HE and R&I in Poland primarily focus on technology transfer, copying US-style commercialisation efforts, which are unlikely to yield the expected results, while disregarding a broader knowledge exchange and the role of HEIs in addressing societal challenges.** In the past, funding streams have framed the third mission in narrow terms, as a tool for diversification of HE funding, rather than as long-term industry and community engagement that is embedded in, and delivered through teaching and research. In addition, the administrative procedures and governance processes of institutions remain a barrier to industry cooperation and community engagement (see Chapter 4.1 on Governance). **The current policy lacks focus on the third mission, as it is understood in most higher education systems in the world[61], and the HE and system linkages that are of key importance to both innovation system competitiveness and research and education excellence. It also lacks focus on the crucial role of students in knowledge transfer and community engagement.** The MNiSW is aware of these shortcomings and works to ensure that the Law 2.0 will enhance the role of higher education in social development and the innovation-based economy, as well as the social responsibility of science. As of 2018, additional ESIF funding will support HEIs in the implementation of third-mission activities. This chapter focuses on HEIs' role in science-business interaction, and local and regional development, which for most institutions is the logical level at which to focus their third-mission operations.

5.2 Science-business interaction

Much of the current HE policy focus in Poland is on traditional modes of knowledge transfer, i.e. patents, licensing income and research spin-offs based on a patent. While these are frequently-used indicators to assess whether HEIs or countries are successful in transforming public research into innovation, in practice, expectations are often over-ambitious given that only a few universities worldwide have been successful in transforming research into innovation (see Box 5.1.).

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[61] The third pillar of Jaroslaw Gowin's Strategy – Science for You, focuses on the social responsibility of science and higher education, with focus on science buses and other dissemination and awareness-raising actions.

International evidence points to the need for governments and HEIs to adopt a broader approach to knowledge exchange and commercialisation. While patents, licenses and spin-offs remain important channels for commercialising public research, other channels – such as collaborative research (e.g. public-private partnerships), student and faculty mobility in all fields, faculty consulting and student entrepreneurship – are likely to provide a better return on investment as well as to change the culture of higher education institutions.

Box 5.1. Commercialisation results accrue in few universities worldwide

- **Only a few universities are successful at commercialising inventions that they have patented.** In Europe, 10 % of universities account for 85 % of the total income generated by inventions. Most royalties from licensing agreements also accrue from a small number of blockbuster inventions. For example, Stanford's Office of Technology Licensing has received more than 8000 invention disclosures, but less than 1 % of the Stanford disclosures have generated USD 1 million or more in cumulative royalties.

- **The number of academic spin-offs has not significantly increased either, despite continued policy support.** In the United States, MIT generates 22 spin-offs a year, whereas the average number among 157 universities is 4 spin-offs. Europe outperforms the US, Canadian and Australian universities in this measure. Europe generates 2.4 spin-offs per USD 100 million research expenditure, compared with 1.1 for the US and Canada and 0.7 for Australia.

- **Internationally, licensing income is a relatively small source of funding compared to other 'third-stream' activities, such as contract research and consultancy services.** UK universities, which are leading the scene in Europe, make only 2–4 % of their external income out of patenting and licensing, whereas much larger funds come from contract research, collaborative research and professional education (OECD 2013a). Data from the UK Higher Education Business and Community Survey (HE-BCI) indicate that 1 % of income of third-mission sources originates from IP licensing, compared with 17 % for contract research, 6 % for consulting services and more than half of total income for the provision of continuous professional development services.

- **Technology Transfer Offices (TTOs) are the primary driver of commercialisation efforts but international evidence suggests that most TTOs do not generate positive net returns (or break even) from patenting and licensing.** Most TTOs have therefore expanded their activities to a wide range of IP-management and supporting activities (e.g. patent scouts, consulting), marketing non-patent services, administering proof-of-concept and seed funds for entrepreneurship, and promoting an innovation culture.

Source: OECD (2013a) Commercialising Public Research. New trends and strategies

5.2.1 Science-business results in Poland

The results in science-business cooperation in Poland have been disappointing:

- **Collaborative R&D remains small in volume and the quantifiable outcomes of science and industry cooperation modest, including low counts of joint publications and co-patents.** Only 10 % of innovative companies cooperate with HEIs. In public-private scientific co-publications, Poland produces only 3.7 publications per 1 million people compared with the EU average of 28.7, also trailing behind its regional peers the Czech Republic (10.2) or Hungary (23.2) (EC 2016b and 2017c). (see also figure 13 in Chapter 2).

- **Universities earn very small revenues from knowledge transfer, including technology licensing or sales although patenting activity has increased.** Higher education R&D funded by the private sector represents only 0.02 % of Poland's GDP in 2015, a marginal amount of funding and one of the lowest shares in Europe. University incubation activities are embryonic and spin-offs from university research scant. The patents generated often lack commercial applications and the high patenting activity of some HEIs can be partly attributed to the fact that counts of granted patents are part of the criteria for evaluating scientific units, which affects institutional funding. (In general, invention disclosures are a poor measure of commercialisation as they do not reflect any information about the commercial potential, unlike licences executed.)

- **Technology Transfer Centres (TTCs) have limited relevance across the system.** The scope of Polish TTCs suggests that they fall short of fully fledged TTCs, and focus on a narrow portfolio of activities. Most TTCs have limited capacity in business and strategy development, and lack managerial and marketing skills (See e.g. Lisa & Majewska 2016). The few successful TTCs are a result of the efforts of innovative individuals, and the drive is lost once the person moves on. Most TTCs do not have any focus on enhancing students' role in knowledge exchange or innovation. As universities cannot keep shares in spin-offs, special purpose vehicles have been established, but their results also seem uneven.[62]

- **With few exceptions, research institutes which were established to operate in close partnerships with industry have a limited scope of knowledge-transfer activities**. Aggregate revenues from knowledge transfer incurred by research institutes were lower in 2013 than in 2010, i.e. before the HE and science reform that aimed at increasing the industry cooperation.

Reasons for the modest performance in commercialisation are manifold (see also Klincewicz & Marczewska 2017) but many of them seem to be based on policies linked to funding, governance, quality assurance and evaluation, as well as the economy's structure and the absorptive capacity of the business sector:

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[62] A full analysis of the special purpose vehicles was not possible within the scope of this PSF review.

- **Poland's R&D spending, business expenditure in R&D (BERD) and higher education expenditure in R&D (HERD) is at a low level, and statutory funding is spread across a large number of institutions.** The fragmentation of R&D capacities within universities, among universities, and between universities and PROs further undermines development efforts. While there is a strong correlation between the share of researchers employed by the business sector and innovation outputs, Poland is among those countries which are catching up in terms of researchers and business enterprise researchers (EC 2016b) (see Figure 24 below)

- **The focus of public funding programmes on scientific excellence is not matched by a similar focus on actions with economic or societal impacts, limiting the potential orientation of universities.** There is no dedicated funding stream for HEIs' third mission or challenge-driven interdisciplinary projects. The recently introduced legal obligation for higher education institutions to spend 2 % of their core funding on strengthening technology transfer activities, and the Innovation Inbubator+ programme to broaden TTCs' scope, do not adequately address these needs. Until recently, universities and research institutes were not incentivised to diversify funding sources.[63] Interviews also highlighted that risk aversion by both HEIs and domestic firms, combined with their need to absorb public funding (national and EU), has led to the situation where the institutions with the greatest research capacity win national projects too easily and do not need to look for industry collaboration.

- The criteria for recruitment, promotion or performance evaluations of HE staff do not acknowledge industry and community engagement, commercialisation of R&D results and other knowledge exchange. University staff generally lack key performance indicators linked to knowledge exchange and transfer. In some regions, a small number of academic staff are involved in knowledge exchange and expert work (assessing projects applying to regional, national or EC operational programmes). In the new plans for the evaluation of research performance, the criterion for business cooperation has been strengthened to match the weight of the scientific indicators.

- **University governance with no external representation drives institutions to become inward looking, with a focus on supply-driven education and R&D based on the abilities and interest of the HE staff, rather than on industry- and society-relevant research and education**. Despite some exceptions, there is also a lack of industry involvement in the design and implementation of learning and research programmes in public HEIs, including most higher vocational schools.

- **There is a lack of culture of university-industry collaboration.** There is a weak articulation of the business demand for HEI and PRO services and low absorptive capacity in domestic businesses. Only a small portion of enterprises report cooperation with scientific organisations. In addition to the usual business concerns about the different concepts of time and

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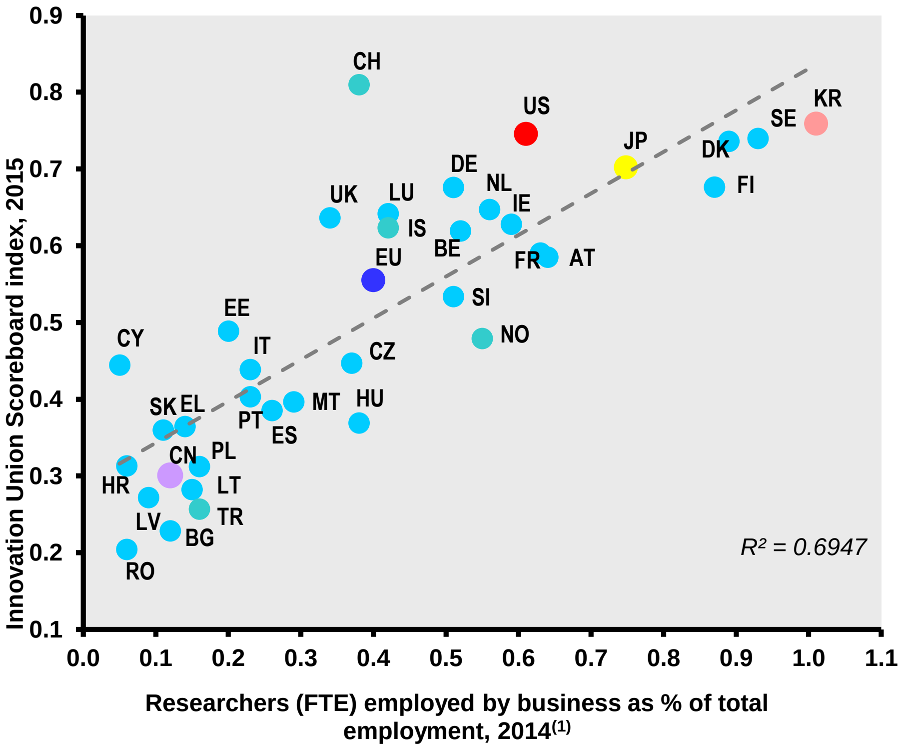
[63] There is also a new requirement for public science organisations to spend at least 0.5% of the institutional R&D funding allocated by the government on the commercialisation of research results.

confidentiality, interviews showed that the Polish industry and chambers of commerce are sceptical about the quality and usefulness of the research conducted by universities. Academia lacks an understanding of industry standards and calibration requirements, and funding for maintaining laboratories.

- **There is a lack of understanding of the key role of students and graduates in knowledge exchange and transfer in both industry collaboration** and community engagement. The recent launch of the Implementation doctor scheme (see Chapter on Human Resources) is a welcome but in most cases not a sufficient step if more attention is not awarded to ensuring work-based and experiential learning opportunities for all students.

Figure 24: Innovation Union Scoreboard index, 2015 versus researchers (FTE) employed by business as percentage of total employment, 2014



Source: EC (2016b) Science, research and Innovation Performance in the EU 2016. Page 49

5.2.2 Ownership of IPR from government-funded research

The EU and OECD countries have developed diverse policy frameworks regulating ownership of IPR derived from government-funded research. Key approaches include: the institutional ownership, Professor's privilege (Inventor Ownership), the free agency model and granting licenses for IPR free of charge. See Box 5.2.

Poland's approach to the ownership of IPR from government-funded research has changed twice in a few years which may have contributed

to a lack of competence and knowledge about IPR. Currently a mix of institutional and inventor ownership is implemented. The 2016 First Act on Innovation reduced the bureaucratic burden of the legal procedures and prescribed that the inventor ownership will be considered only when explicitly requested by the academic inventor.

Most EU countries have adopted the institutional ownership model, but often allow universities to overrule national IPR regulations through their own bylaws, e.g. by negotiating different IP arrangements with third parties. Interviews revealed a degree of confusion among HEIs in this matter, while others claimed that the current public aid and public finance regulations limit the flexibility in the implementation as their restrict the ability of individual scientists to engage in IPR commercialisation that is not driven by the HEI but individual scientists.

Whatever IPR model is used, it is important to ensure that flexible approaches are favoured and that the academics report their IP holdings to their universities. Government should also carefully examine the IPR policy of the Fraunhofer Gesellschaft in view of the current plans to reorganise the research instituted (see the Learning Model 5.7.1.)

Polish institutions will be increasingly faced with the issue of IPR of graduate students and non-faculty/employees engaged in research. While the status of graduate students may vary (employees or non-employees), they typically work on research projects funded by university or outside resources which may lead to tensions between universities and students over IPRs. Institutional approaches vary. For instance Aalto University in Finland (well known for its active student/graduate entrepreneurship scene) allows students to own any invention made during their studies: students will be assigned ownership if they are not university employees and not using more university resources than those available to all other students.

While the IPR ownership model is not a magic bullet that can solve the challenges in knowledge transfer, the key issue is to ensure that the HEI and PRO staff have incentives to declare their inventions. The experience from Sweden, with a long tradition of Professor's privilege, shows that the general incentive structures of universities to engage in innovation processes are much more important, mainly through interaction with industry and public agencies, and even more important are the business innovation system dynamics, without which business demand for and take-up of academy-based inventions will not happen.

Box 5.2. Ownership of IPR derived from government-funded research

Most European countries, with the notable exception of Sweden, have adopted a system of **institutional ownership**, often supported with legal and policy arrangements where universities can overrule national IPR regulations through their own bylaws. An argument in support of institutionalised IP is that HEIs and PROs are financed through taxpayers' money and provide the infrastructure and staff and a secure position for researchers, so the revenues from the invention should not belong to the individual inventor alone. A counter-argument is that professional TTO structures may reduce incentives for spin-offs, as there are incentives for TTO managers to license out IP to existing firms to receive quick and safe returns.

Professor's privilege or inventor ownership implies a system of exclusive inventors' rights. An argument in favour of Professor's Privilege is that it can boost potential spin-off creation or reduce bureaucracy and infrastructure costs. The counter-argument is that it can lead to underdeveloped commercialisation infrastructures and weak patenting performance for HEIs and PROs as they lack knowledge of the IP generated with their resources and cannot build up a revenue stream (OECD 2003).

The Free Agency Model implies vesting ownership with inventors but maintaining university ownership, but researchers are given the choice between their university TTO or an agent elsewhere who might be more appropriate for the commercialisation, e.g. due to field-specific expertise. The rational is that the benefits will improve the efficiency and performance of TTOs by creating competition. Concerns include the limitations on adjusting TTO performance through competition, the potential capacity constraints of external university TTOs, regional and local economic development issues, overlapping interests etc.

Granting licenses on IP rights free of charge. For example the University of Glasgow introduced in 2010 the Easy Access Programme to provide free access to university inventions on a royalty-free and fee-free basis. In 2017, the Easy Access Innovation Partnership[64] covers 27 university and PRO partners and offers an open opportunity mechanism which allows companies and individuals free access to technologies.

Source: OECD (2003) Turning Science into Business: Patenting and Licensing at Public Research Organisations. OECD Publishing. Paris. http://dx.doi.org/10.1787/9789264100244-en.

5.3 Higher Education Institutions in local and regional development

The scope and focus of the current review does not allow a detailed analysis of HEIs' role in local and regional development in Poland. However, **for most higher education institutions, the city and the surrounding environment provides the natural framework for industry collaboration and community engagement. This engagement is relevant to all HEIs in Poland, as it can take many different forms depending on the capacity of institutions and the needs and assets of the region, and consequently does not exclude internationalisation and global connections or impact.** See the Learning Model on 6.7.3. Entrepreneurial universities in different contexts.

With a few exceptions, and despite the national and regional smart specialisation strategies anchoring HEIs in the regions, the local and regional engagement of Polish public higher education institutions – including industry

[64] For more information see Easy Access at http://easyaccessip.com.

collaboration, skills development, community engagement and entrepreneurship activities – is weakly reflected in the higher education policy and institutional set-up, and often a result of bottom-up processes within institutions or the administrations of cities (e.g. Wroclaw where the role of HEIs was reviewed by the OECD in 2013, see Puukka et al. 2013) or regional governments as is the case in the Pomorskie Region or Pomerania (see Box 6.3.)

Box 5.3. The Pomorskie Region: mobilising HEIs for regional engagement

The regional government of Pomorskie has taken a leadership role in engaging HEIs in knowledge-based regional development. It engages HEIs in dialogue on regional development through the Entrepreneurship Council and Education Council, and takes part in HEIs activities (e.g. through the Council of Rectors). Key mechanisms for mobilising HEIs for region building include:

- The Pomorskie Region Development Strategy 2020 that determines the main operational objectives of the region. One objective is to develop competitive higher education by attracting HE students and staff, enhancing consolidation of HEIs and cooperation (mutual cooperation and cooperation with business, secondary education and foreign partners); and developing a higher vocational school network, aligned with the labour market needs in subregions. The development strategy is supported by six Regional Strategic Programmes including the "Pomorskie Creativity Port" which plays a role of the Regional Innovation Strategy and smart specialisation, and involves HEIs (also VET) and their multidisciplinary collaboration.

- Cluster-based policy and smart specialisation: for the past 10 years, the region has been in charge of coordinating the regional cluster policy which in 2013 formed the basis for the new regional economic policy with a focus on smart specialisation. The region coordinates the entrepreneurial discovery process involving the main HEIs. Four smart specialisations were identified with the active participation of clusters and the business and science sectors in 2015.[65] There are councils for each Smart Specialisation, with HEIs' representation, as well as horizontal projects, mainly proposed by HEIs. The region monitors the development of smart specialisation in terms of R&D and skills development, using external expertise (e.g. OECD, Deloitte, Pomorskie Labour Market Observatory), and expects the results to influence the HEI learning offer.

- EU-funded activities: 2007-2013: e.g. scholarship to PhD candidates (InnoDoktorant: 268 PhD candidates in innovative areas). In 2014-2020, 13 R&D infrastructure projects (EUR 20 million), 6 projects for Higher VET infrastructure (EUR 17 million) and the TriPOLIS cooperation programme between business incubators and science and technology parks to encourage science-business cooperation. The region is also creating a mechanism supporting incubation of R&D projects, supporting participation in

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[65] (i) Offshore, port and logistics technologies; (ii) Interactive technologies in information-saturated environments; (iii) Eco-effective technologies in energy, fuels and construction; and (iv) Medical technologies in ageing.

international projects in smart specialisations, and influencing HEIs' learning programmes through opinions

- Regional funds to support the programmes with and for HE. These include the Study in Pomorskie programme to attract foreign students (co-funded with eight out of nine public HEIs in the region), scholarships for the best talent (40 students per year since 2002), Marshal award for the best thesis on topics related to the region (to be launched in 2018) as well as various meetings and events according to the needs and demand of business and HE.

Based on its long experience in enhancing the role of HEIs in regional development, the Pomorskie region proposes a strengthened role for regional authorities in the regulation and financial instruments of co-establishing the HE offer, as well as the transfer of the European funds related to HE from national to regional level to facilitate long-term policy planning, instead of ad hoc actions based on annual budgeting, and a consultation of regional governments on HE reforms and changes and national funding for HEIs consolidations.

While Pomorskie region has made commendable progress in engaging higher education institutions in the development and implementation of regional strategies, the situation in other regions is mixed and typically manifests itself in:

- **A lack of strategic anchoring of local and regional development within individual higher education institutions and within the "higher education system" in localities with multiple institutions.** Regionally relevant action depends on the commitment of individual staff members or students (or in a few fields directly involved in smart specialisation strategies), but is less frequently reflected in the university strategic development, curriculum development or internal funding. The lack of external representation in the university governance drives inward-oriented universities, while higher VET is unevenly spread across the country and regions and lacks capacity and attractiveness (see Box 5.4 below).

- **HEIs are driven by national policies and nationally allocated funding streams which results in a weak legitimacy for the needs of the cities and regions within the institutions.** Regionally and locally relevant activities may be perceived as separate from research and teaching, which remain supply driven, based on the interests and abilities of the HE staff, rather than led by demand in the local and regional labour market and society.

- **University governance is based on a federal model in which individual departments are autonomous in relation to the central administration** (see Chapter on 4.1. Governance). In many cases there is a lack of processes which can reconcile the potentially competing agendas of different units which benefit from direct funding allocation based on research quality. University central administrations often lack the capacity to exercise strategic leadership or influence important horizontal services that could enhance knowledge exchange at the regional level. For example, the TTCs have significant untapped potential to provide support for the development of technological capacity of the companies operating in the respective region, but are often not active in establishing and maintaining cooperation with business, implementing technological change or technology commercialisation.

- **There may be a co-ordination deficit within the local/regional higher education system and a lack of a long-term vision and inter-institutional mechanisms that can bring together different institutions which are now increasingly competing for students.** The involvement of HEIs in the design and implementation of Regional Smart Specialisation Strategies has been uneven across regions and focuses only on a part of the knowledge fields in HEIs. The lack of an integrated HE sector implies lack of collaboration, learning pathways and sharing of resources among HEIs and universities and higher vocational schools and earlier levels of education.

- **Joint university activity for the city/region and shared learning among universities often remains informal, ad hoc and non-strategic.** The coordination of information and action on the part of the various public agencies, universities and other stakeholders may also need improvement. In some cases, this vacuum has been filled by initiatives from the city regional government as has been the case in Wroclaw and the Pomorskie region.

- **The evidence base is underdeveloped.** The system of information and data gathering about the local and regional environment, and the successes and failures of the activities by higher education institutions and intermediary agencies is limited in scope and quality. While the government has invested in the development of a graduate tracking system and there is also a sophisticated parametrisation system for research evaluation, there is a lack of information and robust data in terms of skills gaps, socioeconomic background of students, student progress, scope of work-based learning activities, industry demand for RDI, business formation and returns on public investment, which make it difficult to evaluate the outcomes of local and regional policies and institutional practices, and design more effective policies.

Box 5.4. Higher vocational schools in regional development

The 35 public higher vocational schools (PWSZ) have a special role in regional development and an obligation to include regional representation (employers) in their governance, but the results remain limited and uneven across institutions and regions. Public PWSZ are unevenly spread across Poland. The sector suffers from rapidly declining student enrolments and frequently offers low-cost learning programmes which are weakly aligned with local needs. The graduate employability shows mixed results across institutions depending on the education offer and its alignment with local needs.[66] Good examples of PWSZs which match their education offer with the local industry demand include Kalisz PWSZ, with an active R&D Centre for the aeronautical industry,

[66] PWSZ students mainly pursue studies in social sciences (5 525 students) and medical science and health sciences (4 022 students). The graduates in social sciences face a two times higher risk of unemployment than graduates in health related fields.

and Wielkopolski Cluster Airport. Many PWSZ do not offer studies that would serve local industry or lack an environment with large employers (e.g. many PWSZ in Eastern Poland) which leads to difficulties in offering practical training. There is a lack of systematic inclusion on work-based learning opportunities in the PWSZ study programmes.

A recently launched separate funding formula for PWSZ (see Figure 20) incentivises industry collaboration (10 %) but is mainly focused on student enrolments (55 %), with weights on practical training, and the staff (45 %), with a high weight for international professors.

As noted in Chapter Three, Poland is planning to reform higher vocational schools by encouraging some of the existing higher VET institutions to transform themselves towards a dual-university model alternating work-based learning with studies, while mandating the rest to have a practical training period. The current plans for the PWSZ sector have low aspirations given the socio-economic needs and the demands of the diversified student population. For example, the planned duration of the practical training period is low by international standards and should be seen as an interim goal only. The MNiSW also funds the costs of the practical training period because "the Polish employers are not used to paying for trainees". Authorities should actively seek ways to enhance cost sharing with employers. A serious cause of concern is the lack of focus on adult education and reskilling and upskilling activities. The underdevelopment of vocational higher education is a major shortcoming of the Polish HE system and the government should seek ways to develop a robust university of applied sciences sector including dual universities.

To face these challenges, more concerted efforts and a systematic place-based approach to human capital and skills development is needed as part of broad-based, but clearly focused, regional innovation systems. Despite the declining youth cohorts, higher education opportunities should be expanded by developing an integrated and coherent higher education system at the local/regional level, and drastically stepping up lifelong learning opportunities (reskilling and upskilling) to reduce inequalities and support economic growth and community development. Universities' learning programmes and research activities should become more relevant, demand-driven and aligned with the needs and opportunities of industry and society, and existing and emerging clusters and challenges. Stronger incentives and improved governance systems are necessary to mobilise universities for local and regional development and to improve their quality, productivity and international competitiveness. In order to improve regional development outcomes, evidence-based decision-making needs to be strengthened within higher education institutions, as well as at the national and regional levels.

In addition to the dedicated competitive funding stream for the third mission, the government could consider a strengthened role for regional authorities in the regulation and financial instruments of co-establishing the HE offer. This could be accompanied by the transfer of European funds related to higher education from the national to the regional level in order to facilitate long-term policy planning, instead of ad hoc actions based on annual budgeting. In any case, consultation of regional governments on HE reforms and changes and national funding for HEIs consolidations will be necessary.

An agreement could be reached whereby universities in a particular region could consolidate their learning offer and enhance their cooperation. Such a programme could run for five to seven years as a pilot project that would be evaluated and the results disseminated afterwards throughout the university system.

As noted in Chapter Three, **the government could consider conducting an assessment of current and planned capacity against anticipated student numbers and identify gaps in staff and infrastructure to ensure sustainable regional provision of higher education. The co-ordinated negotiation and planning process could be led by the central government in collaboration with the regional governments. As an intermediate step, measures should be taken to strengthen flexible multi-provider learning and extension centres with support for industry development.** Support should be provided for centres that draw on a range of providers, including both universities and higher vocational schools, to ensure the broadest possible choice and the most sustainable future. When developing or rationalising the network of education providers, care should be taken to ensure that the region will have access to relevant lifelong learning services and business-related services.

5.4 Financing pro-innovation activities

In order to enhance innovation outcomes, the Polish government has over the years implemented a broad portfolio of support schemes for science-industry cooperation and knowledge exchange, targeting both companies and the public science sector. The funding principles of the key Polish agency NCBiR have been discussed in Chapter 4.2.[67]

NCBiR makes use of competitive calls as a funding allocation mechanism. Competitive funding is a transparent and fair way to allocate funding but care should be taken not to use too many different funding streams as is the case with the NCBiR now (see also Box 5.5. for some of them.)

Box 5.5. A selection of Poland's pro-commercialisation programmes targeting HEIs and PROs

Significant investments have been made to enhance the commercialisation results in recent years. The total investment amounts to EUR 271.6 million. The outcomes of these efforts are not clear:

- "Bridge Alpha" co-finances R&D projects in the early stages of development – during the proof-of-principle or proof-of-concept stages – through private investment vehicles (similar to seed capital funds) called Alphas. In the first edition of the project, which ended in 2015, PLN 51 million (EUR 12 million) was invested through 10 Alphas. Second edition was launched in 2016 with a total budget of PLN 450 million (EUR 105 million). The implementation with 19 Alphas began in February 2017.

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67 The panel did not meet PARP, another important funding agency in this domain.

- "Demonstrator+" aimed at strengthening the transfer of research results to the economy by supporting R&D projects leading to a new technology or product at demonstration scale. The total budget of the project was PLN 423 million (EUR 100 million).

- "Spin-Tech" (2014-16) supported the activities of special purpose vehicles created by PROs, in particular those set up by universities to commercialise the results of R&D work through taking stakes in spin-off organised by researchers in order to implement results of research and development work. The total value of this NCBiR-run programme amounted PLN 113 million (EUR 27 million).

- "Patent-Plus" aimed at supporting scientists, research institutions and entrepreneurs in the process of applying for European and international patent protection. The total budget of the project was PLN 40 million (EUR 9.5 million).

- The "Innovation Incubator" programme supported entities active in commercialisation of the results of R&D work. The first edition of the programme, which finished in 2015, supported 14 entities, mostly technology transfer centres at universities with a total budget of almost PLN 20 million (EUR 4.8 million). Early evaluation of the programme showed positive impacts: programme stimulated universities in their licensing and spin-off activity. The second edition, under the name "Innovation Incubator Plus", which integrates the previous "Innovation Incubator" and "Innovation Agent" programmes in a revised formula, started in 2016 with a budget of PLN 50 million (EUR 12 million). As of February 2017, 20 beneficiaries (single institution or consortia of universities, its SPVs and other PROs and/or its SPVs) were selected in competitive procedure and have begun their activities.

- The "Innovation Agent" programme supported university faculties cooperating with technology transfer centres by appointing innovation brokers who established university-business cooperation in order to apply research results in enterprises. The first edition of the project that finished in 2015 had a budget of PLN 5.6 million (EUR 1.3 million). Funding targeted 29 brokers who worked with 29 departments of 18 universities.

Prior evaluations underline that the pro-innovation funding incentives have "failed to change the motivations, perceptions and behaviours of researchers and entrepreneurs or organisational practices" (Klincewicz & Marczewska 2017). The background material analysed by the panel identifies a number of support mechanisms that have not generated expected results or appear to be misguided:

- The NCBiR-funded R&D programmes require a joint application by consortia of companies and scientific organisations, but collaborations collapse when the time-limited project funds come to an end.

- Innovation vouchers for companies were launched to finance contract research at HEIs, but have limited financial value and are used for analytical services rather than RDI.

- The majority of R&D co-funding schemes available for companies, particularly schemes based on ESIF, allow the beneficiaries to subcontract parts of the project but do not incentivise cooperation with PROs.

- Extensive support for innovation brokers and incubators at universities has contributed to only a small number of licensing agreements.

These perceptions highlight **the need for a detailed analysis of business sector RDI and the industry-academia interaction.** The building of entrepreneurial institutions takes time and the key element in this respect is the development of an innovation ecosystem and a culture of collaboration (See the Learning Model 6.7.2. on 'Entrepreneurial universities in different contexts'.) Project-based collaborations that end when the project funding comes to an end may have contributed to a change in the collaborative culture (e.g. Polish enterprises with experience in university collaboration perceive it in more positive terms), but without a thorough analysis of university-business collaboration this is difficult to confirm. In addition, vouchers which encourage small-scale collaboration and provision of analytical services can also be important steps in engaging students in knowledge transfer, boosting faculty consultancy and developing more extensive collaboration.

The government could consider addressing the current gaps in the funding mechanisms: As noted above, there is no dedicated funding for HEIs' third-mission activities, similar to the UK's Higher Education Innovation Fund (see Learning Model). NCBiR funding lacks a focus on technology readiness levels below 7, while the NCN project evaluation criteria are strictly oriented towards fundamental research, implying that any practical uses or societal or economic impacts of projects are eliminated.

An evaluation of the programmes of both NCN and NCBiR would be advisable, given their weaknesses in stimulating science-industry links. For example, the Tango 2 jointly run by NCN and NCBiR (Proof of Concept grants) is the only programme bridging fundamental and applied research funding. It aims to enhance the commercialisation of successful results of NCN projects, but could provide better results if the university TTOs had business development skills. Currently, the support seems to be used by scientists while the scheme brings limited benefits to business.

Despite the NCBiR funding for strategic R&D programmes for science-industry consortia, **what seems to be lacking in the portfolio is the funding to incentivise long-term university-industry collaboration through public-private partnerships.** Based on the analysis carried out in the context of the PSF Mutual Learning Exercise on complex public-private partnerships (EC 2017c by Luukkonen et al., the panel suggests a useful learning model from Sweden where the Competence Centres Programme has, since 1995, systematically twinned industry with HEI research agendas, competence and personnel to solve basic research issues relevant to innovation. Bringing together HEIs and firms of high international level, these public-private partnerships have helped steer HEIs' research agendas towards new and industrially relevant areas, build long-term university-industry collaboration, and facilitate competence development as well as employment in industry. In 20 years nearly 30 centres have been selected, each funded for a 10-year term. Competence Centres have had significant systemic impact on HEIs, incentivising them to mainstream "competence centre" mechanisms, excelling in third-mission activities. See the Learning Model 6.7.3. on Competence centres in Sweden'.

The risk aversion by domestic firms and HEIs combined with the necessity to absorb significant amounts of EU funding has contributed to a large public role in the innovation system which may have led to the funding of initiatives and innovations which are not commercially viable without subsidies. Interviews showed a tendency to perceive innovation as "new knowledge" rather than "commercially useful knowledge". The strong government presence and publicly-driven innovation system may be undercutting its own goals of developing entrepreneurship. The risk is that the ability to attract public funding for an idea becomes the measure of success, rather than the success in the market (a product that people want to purchase; the amount of commercial return generated). Universities, the authorities and the public agencies supporting RDI seem to measure their success in terms of their ability to absorb public funding. While there is still lack of government finding for RDI compared with the EU average, the interviews highlighted the risk aversion of domestic industry and higher education institutions: Domestic industry embarks on R&D collaboration "only if dedicated public funding is available", while HEIs with the biggest research capacity and lack of culture of science-industry collaboration win both nationally and EU-funded projects too easily and do not need to look for industry collaboration ("they wait passively for industry to approach them."). Universities should be encouraged to go beyond their traditional role of knowledge producers and embrace a more robust conception of innovation.

Poland's government should foster a sense of responsibility to show an overall positive return to public investment. Poland receives millions of euros per year as transfers from the EU. A significant part of this funding is allocated to HEIs and businesses. It is expected that these investments will pay back the public investment through the generation of increased private sector activity and valuable publicly-provided advances that would not have come to be without the initial government investments. At the time of the review, there was limited evidence of a payback mentality among public authorities, and HEI representatives and business.

5.5 Balancing research and innovation policy

Currently, the ambitions and analysis of the Polish research and innovation policy reform focus on HE and science, with less attention to the business side of the innovation system in general and system links between business innovation processes and R&D-developments and HEIs' research and education activities. Policy makers should acknowledge that the higher education sector is usually not the main driver of the innovation system in the leading innovation countries in the world, although it is important to national innovation systems and competitiveness, and can even play a leading role in regional innovation systems.

Business innovation dynamics are the main driver of innovation competitiveness, backed up with innovation incentives (competition, regulation, experimental economy culture). Public demand (high-technology defence, communication and physical infrastructure, health) plays an important role in influencing the innovation climate and incentive structures through user-producer interactions with business, as well as different kinds of public procurement and public-private partnerships. The supply-demand links between the academia and industry are vital for the innovation system dynamics, and also to the contributions of HEIs to innovation. HEIs' governance and incentive structures to develop strategies and engage in university-industry interactions are also key features. Internationally, universities are increasingly seen as key attraction factors for globalised and globalising industrial groups and new innovation-based firms. A case in point is the Danish wind energy industry, which started from the public need for energy security and sustainable energy supply along with traditional know how. This case study shows how the stimulation of a home market can lead to global competitiveness supported by universities' knowledge transfer and skills development. See the Learning Model 6.7.4. on Wind-power industry in Denmark.

In Poland, where private sector research is still smaller in size than public-sector research (despite doubling in the last five years) **and the demand for public-sector research output is limited, university reforms, including a well-functioning HE research sector and governance and regulations, can be a key to boosting innovation**. Without such reforms, universities are unlikely to become attractive partners for the private sector.

For future development, the government needs to ensure that higher education and science sector reforms will be supported by a detailed analysis of industry-academia interaction and the key system dynamics related to such interactions. This is important in order to avoid the risk of misleading the reform process, especially a linear view of the relationship between research and innovation determining the policy focus. System linkages are key dimensions not only in innovation system competiveness, but also in research and education excellence.

The panel also proposes **a follow-up review of a broader innovation landscape, including instruments and mechanisms contributing to science-industry links**. Inspiration could be found in the analysis of Sweden's national research and innovation policy challenges and opportunities, which highlighted the following important elements:

Box 5.6. An example of a system peer review

- University reform;
- Cross-government prioritisation and coordination to address the silo-challenges;
- Incentives and initiatives to address societal challenges;
- Industry-university links through industry-led programmes;
- Internationalisation and internationalisation strategies;
- Sufficient scale of R&D-initiatives for an international context;
- Incentives and stimulation of SME innovation.

Source: OECD (2016e) Review of National Research and Innovation Policy: Sweden. OECD Publishing. Paris

5.6 Recommendations on higher education's third mission and links with industry and society

Poland's innovation policy should carefully avoid a narrow focus on science and technology. Investments in the science base will not alone guarantee innovations or societal and economic returns, although HE and academic research are vital for competitive innovation capabilities. Innovation incentives and public demand play key roles in competitive innovation systems. User-producer interactions, public procurement and public-private partnerships are important mechanisms. Cooperation between universities and industry, as well as with the public sector, is vital to the relevance of university research and education to the innovation system and therefore of key importance to national innovation performance. A well-functioning knowledge-exchange model is based on interactive and long-term relationships between universities and industry to determine which research and inventions have opportunities to form the basis of innovation and economic returns. This industry-university learning environment supports the skills and human capital development required to adopt and apply process and product innovations, and works with SMEs as well as large corporations. It measures success in terms of the sustainability and transformation of industry and employment growth.

The panel suggests that the following measures are taken:

Create a demand pull.

- **Acknowledge that business innovation dynamics are a key driver of innovation competitiveness, backed up with innovation incentives (competition, regulation, and experimental economy culture).** Public demand for innovation in high-technology defence, communication and physical infrastructure and health plays a key role in influencing the innovation climate and incentive structures.

- **Conduct a detailed analysis of system linkages and business sector RDI and industry-academia interaction.** System linkages and public-private partnerships fostering supply-demand links are of key importance to innovation system dynamics, as well as to research and education excellence and HEI contributions to innovation. An analysis of these linkages can help avoid the potential risk of misleading the long-term reform process, such as a linear view of the relationship between research and innovation determining the balance and focus of the policy measures.

- **Consider a follow-up review of the broad innovation landscape, including instruments and mechanisms contributing to the science-industry links.**

- **Monitor the R&D tax credit scheme in order to ensure that it stimulates real and innovative R&D activities**. Carefully designed R&D tax credits can play a complementary role in incentivising business R&D. In order to avoid inefficient R&D tax credit schemes, ensure that tax authorities do not evaluate the eligibility of R&D tax deduction, as tax authorities in general are not capable of distinguishing R&D from other activities. The Norwegian R&D tax credit scheme could serve as an inspiration as it involves the research council (RCN) in the evaluation of tax deduction cases, while the tax authority is formally responsible for tax decisions. See the Learning Model 6.7.5. on the Norwegian tax credit.

- **Ensure that the Law 2.0 will contribute to improving universities' capacity to deliver demand-side services to companies, big and small.** A potential pitfall of the Law 2.0 is to ignore the wider innovation ecosystem of which universities are a key element but only one of many components. Horizon 2020 could help both science and industry to improve their levels of collaboration as the European Framework Programme comprises the whole innovation cycle around topics that could form the basis for emerging markets.

Foster university-industry partnerships across all fields.

- **Evaluate the current instruments fostering science-industry collaboration and develop a more robust policy focus on collaborative university-industry partnerships while drawing lessons from international experience in the instrument design.** In particular, a strong focus on better linking SMEs to knowledge producers should be a priority. Strengthen links between HEIs and the business sector on teaching and curriculum design. Ensure that policies and incentives for knowledge exchange and commercialisation are not limited to technological inventions, but also cover advances in the social sciences and humanities. Consider the introduction of Competence Centres and a SBIR-type initiative to the suite of innovation support instruments. See the Learning Model 6.7.3. Competence Centres in Sweden.

***Enhance student entrepreneurship and cross-sectoral mobility for students and staff*.**

- **Invest in student entrepreneurship.** Strive to match global levels of excellence in supporting entrepreneurship in the curriculum, and build comprehensive support programmes encompassing entrepreneurship training, practical experience of creating new businesses for groups of students, and incubation and hatchery facilities together with seed funds for new graduate ventures. Support graduate entrepreneurship by offering programmes at undergraduate and graduate levels where students work in teams to form real companies mentored by entrepreneurs, targeting students from across the sciences, engineering, business and arts and humanities. See also the Learning Model of Entrepreneurial universities in different contexts (especially Aalto University). See the Learning Model 6.7.2. Entrepreneurial universities in different contexts.

- **Develop work-based learning and cross-sectoral mobility opportunities for students and staff in all fields and institutions**. Ensure work-based and/or community engagement learning opportunities for all students with immediate action in vocational higher education institutions. Develop staff mobility schemes between higher education institutions and industry and public sector including the recently launched Implementation Doctor Scheme in line with international experience. Encourage faculty consulting and establish the legal and regulatory framework and the financial incentives to encourage the mobility of highly skilled personnel between industry and HEIs as in Sweden. See the Chapter 4 Learning Model 5.3.5.2. on Denmark's Industrial PhD programme and 5.3.5.4. Professor of Practice (PoP) in the Cornell University in the Chapter on Human Resources.

Develop Technology Transfer Centres and Intellectual Property Rights.

- **Review Technology Transfer Centres and ensure that they assume a broader role in industry collaboration beyond patenting and licensing.** Strengthen TTC professional staff to ensure that TTCs can fully play their role in cementing the value chain. Special skills needs relate to business development, strategy development and management and marketing.

- **Consider establishing shared services in the form of Technology Transfer Alliances (TTAs) at the regional level to overcome the difficulty to generate sufficient deal flow and income to cover expenses of TTCs.** Carefully designed TTAs can lower operational costs and enhance access to highly professional staff while overcoming potential disadvantages (higher co-ordination/communication costs, competition among institutions and capacity constraints of the staff). TTAs have been implemented in Germany where each federal state has at least one regional patent agency (RPA) after the shift from an inventor to an institutional ownership system in 2002. While RPAs serve in some cases both universities and PROs, many institutions also operate their own TTOs. In France, the French National Research Agency (ANR) has established a fund to create Technological Transfer Acceleration Companies (SATT) to reduce fragmentation of technology transfer services regionally. These companies are mainly owned by a consortium of universities and PROs, and will assist in proof-of-concept funding and IP commercialisation. In Ireland, Knowledge Transfer Ireland acts as a central point of contact for firms looking for IP opportunities and research expertise at individual institutions, providing complementary services to TTO structures, collaborating mainly with the more vocationally oriented HE sector i.e. institutes of technology.

- **Revisit the policy framework regulating ownership of IPR derived from government-funded research, including public aid and public finance regulations.** Whichever IPR model is used, design incentives that promote knowledge exchange and ensure that academics report their IP holdings to their universities. These incentives should increasingly cover not only technology disclosure, but also knowledge disclosure (e.g. data sharing). Ensure that the current flexibility to develop internal IPR regulations and processes that can override existing national regulations (e.g. by: (i) providing preferential treatment to researcher faculty staff wishing to license technologies they developed, (ii) allowing professors to establish new ventures, granting leaves of absence, iii) allowing tenure clock stoppage for faculty staff, so that they can pursue commercialisation activities, iv) taking into account the commercial track record of the faculty in the career process) are well known across the HE and science system and facilitate knowledge sharing and peer learning within and across institutions.

- **Allow SMEs and student start-ups preferential access to the HEI/PRO's sleeping patents** which remain commercially unexploited and are held for defensive purposes. The French National Centre for Scientific Research (CNRS) has established the "PR2 – Enhanced Partnership SME Research programme", in which patents are offered to SMEs on favourable terms which could serve as an inspiration.

- **Design policies concerning access to research results, data and instruments**, as well as policies for awareness raising, training and creating links between HEIs/PROs and business and industry.

Foster responsibility and strengthen the evidence base.

- **Foster a sense of responsibility to show an overall positive return to the public investment.** Poland receives millions of euros per year as transfers from the EU. A significant part of this funding is allocated to HEIs and businesses. Ensure that these investments will pay back the public investment through the generation of increased private sector activity and valuable publicly-provided advances that would not have come to be without the initial government investments. Ensure that the universities see job creation as the focus of innovation activities.

- **To ensure return on public investment and stronger accountability, improve mechanisms for following-up and monitoring the success of their programmes at the universities and HE system level.** Strengthen evidence-based decision-making by focusing on a dashboard of key performance indicators to assist management and steering of the universities. New indicators should highlight the economically and socially important uses of research outputs, recognising that the knowledge they produce can be used by actors beyond the traditional research community. Avoid accountability burden and over-emphasis on what can be measured (e.g. patents, licenses and spin outs) rather than what matters (e.g. creativity or social innovation) and lagging indicators (what has happened) rather than leading indicators (e.g. building capacity to act in the future). Continue efforts to develop a robust information system to monitor the performance of tertiary education and benchmark its progress with appropriate comparators in the EU and among other OECD countries.

Mobilise regions and their HEIs.

- **Consider a strengthened role for regional authorities in the regulation and financial instruments of co-establishing the HE offer.** This could be accompanied by the transfer of (more) European funds related to HE from the national to regional level in order to facilitate long term policy planning, instead of ad hoc actions based on annual budgeting. In any case, consultation of regional governments on HE reforms and changes and national funding for HEIs consolidations will be necessary.

- **Consider a pilot programme for universities in a particular region to consolidate the alignment of learning programmes and R&D projects with the industry needs.** Such a programme could run for five to seven years as a pilot project that would be evaluated and results disseminated afterwards throughout the university system.

Take advantage of the HE landscape reform to strengthen linkages.

- **Take advantage of the restructuring of the HE and science system to foster differentiation within and between HEIs and allow for greater specialisation and build-up of excellence.** Better structured centres can improve the industry interface, community engagement and collaboration with the public. Encourage universities to be more outward-looking and entrepreneurial, to raise the number and share of industry contracts, to develop strong centres of excellence, competence centres and to employ an active IP strategy. Consider grouping some adjacent HEIs into single entities with critical mass in order to manage the impacts of demographic change.

Ensure R&D support also for the emerging vocational HE sector while maintaining their distinctiveness as compared with the leading research HEIs (e.g. Knowledge Transfer Ireland, mentioned above, provides complementary services to TTOs, working mainly with the more vocationally oriented institutions such as institutes of technology).

- **Develop a robust vocational HE sector in line with the recommendations in Chapter Three, in order to build a University of Applied Sciences sector.** Ensure that close industry/community engagement, practical R&D and mandatory practical training will become a standard feature of the reformed vocational HE sector and a stronger focus on adult education and reskilling and upskilling activities learning from good practice in other EU countries. When developing the dual-university model launch collaboration with the German dual universities, including the leading DHBW, but particularly the DHGE in Thüringen in Eastern Germany (see the Learning Model on dual universities in Germany). The key points from the German experience include the long development trajectory of dual institutions, the replication of study fields (business, engineering and social studies) in institutions, close contacts with the local industry which sends the student to the dual university, and the funding model with the costs of the study programmes covered by the respective federal state, while the business partner pays a monthly grant to the student-employee.

5.7 Learning models

5.7.1 Fraunhofer's IP strategy

Germany's Fraunhofer Society licenses out its IP and is also involved in patent pools. FG generates high-value patents in collaborative and research projects – whether proprietary, publicly funded or in industry cooperation. This "background IP" makes the FG an attractive place for industry partners to source new knowledge and expertise. At the same time, each new project gives rise to further intellectual assets. This "foreground IP" evolves from specific orders while also strengthening the existing knowledge base. The interaction between background and foreground IP benefits both current and future research work.

The Fraunhofer Institutes commercialise IP through: (i) Contract research, (ii) Out-licensing, (iii) Use of IP to acquire new projects and (iv) Spin-offs and company participation.

In contract research, the Fraunhofer Institutes follow an investment-oriented approach. The collaborating firms receive the proprietary rights on products, prototypes and other materials developed with the Fraunhofer Institutes. In addition, firms receive a non-exclusive license for their specific application related to inventions, IPR and know-how ("foreground IP"). In exceptional cases, firms receive unlimited exclusivity related to foreground IP.

Licensing out without a tied link to contract research is of limited importance for most Fraunhofer Institutes. Licensing out is used because: licensing is not seen the core business; the preference of not owning IPR is interesting for potential licensees; and the risk of irritating potential future clients missing knowhow in commercialising IP. Consequently, possible licensing revenues are not fully exploited.

Licensing options:

- Carrot licensing is the offer by the patent owner to license out the protected technology and to provide the necessary know-how. The license fee is agreed in advance of use. It is often granted exclusively to a particular application field.

- Assertive licensing is granting a non-exclusive license to the user following detection of an unlawful use. In this sense, an unauthorised and unpaid use is transformed into an authorised, paid license ("ex-post licensing").

- Patent pools are utilised via non-exclusive licenses by different patent owners in the pool. The pool management is addressing both potential licensees and is also investigating alleged violations. Patent pools are therefore a mixture of carrot and assertive licensing and represent a particularly efficient licensing option.

The IP strategy has helped the Fraunhofer Institutes to: (i) increase the Institutes' innovative potential, (ii) allow a wide range of IP applications, (iii) protect firms' interest (hence the possibility of exclusive rights), and (iv) to improve firms' and the Institutes' competitive position.

Source: OECD (2013) Commercialising Public Research: New Trends and Strategies.

5.7.2 Entrepreneurial universities in different contexts

Imperial College (UK). Imperial College (est. 1907) is among the top 10 universities in global rankings. Imperial College brings together STEM, medicine and business and provides a multidisciplinary response to society/industry challenges. Knowledge exchange has been part of the university since its inception. Imperial College's technology transfer office – Imperial Innovations – has developed from a standard TTO into an independent, listed company with Imperial College as a shareholder of 30 %. Imperial Innovations has a 15-year collaborative contract for technology transfer services with the Imperial College. In addition to knowledge transfer, Imperial Innovations also develops health and tech businesses from Oxford, Cambridge, UCL and Imperial College. The key strengths of Imperial College are its reputation and profile – Imperial College combines world-class science and technology, which attracts international talent. It nurtures interdisciplinary research, development and innovation. It has a culture of innovation and knowledge exchange. Moreover, it has strong industry links which bring funding. It is a well-managed university with lean decision-making systems. Being able to make decisions is a key asset for any higher education institution nowadays, since key to innovation is speed and agility.

Graham R. (2014) Creating University-based Entrepreneurial Ecosystems.Evidence from Emerging World Leaders. MIT-Skolkova Initiative. MIT. http://www.rhgraham.org/RHG/Recent_publications_files/MIT%3ASkoltech%20entrepreneurial%20ecosystems%20report%202014%20_1.pdf

Aalto University (FI). Established in 2010 through merger of three HEIs in technology, art and design and business, Aalto University has played a key role in the national reform of higher education. It has benefited from both investment by industry and a state matched funding scheme. The strength of Aalto is surrounded by 800 companies in Otaniemi close to Helsinki where Nokia used to have its seat, and where the State Technology Center is based. Aalto University's innovation ecosystem is based on long-term (10-15 years) university-industry partnerships. It facilitates student-led entrepreneurship with the focus on developing a regional hub for high-growth entrepreneurship; it takes no IP ownership, no revenue share or equity. The Aalto Entrepreneurship Society AaltoES provides a vibrant student entrepreneurship community supported by the start-up community in Helsinki. One of the biggest successes is the SLUSH start-up conference which attracted 17 500 participants, 2 300 start-ups, 1 100 investors and 600 journalists throughout the world to Helsinki in November 2016. SLUSH is the biggest start-up conference in Europe, but remains a non-profit, student-driven activity. In 2015 a science track was included in SLUSH, which enables scientists from different universities to do their pitching. Start-up winners include a free digital student card for all higher education and all secondary education students in Finland. This idea was put forward by student unions which established a company focused on digital solutions for students.

Source: Bertram, Puukka, Blakemore, Jeyarajah (2017) 7th European University-Business Forum: University-Business Cooperation - For Innovation and Modernisation. Forum Report. 6 - 7 April 2017 Brussels. European Commission.

Chalmers University of Technology (SE) started as a private industrial school in 1829 with a strong scientific orientation. In 1937, Chalmers was absorbed into the Swedish state-owned system but then opted out in 1994 to become a private foundation university but still receiving public university funding. To help jump-start structural changes, the Swedish government provided Chalmers with a loan that was instrumental in starting spin-off activities. In the late 1970s, Chalmers launched activities to strengthen entrepreneurship and innovation with the establishment of a Chair in Innovation Engineering and the Chalmers Innovation Centre to facilitate knowledge exchange with industry. Chalmers developed incubators to spin-off companies, innovation courses, industrial contact groups and a major science park close to the campus. Early in the 1990s Chalmers was well prepared to receive NUTEK funding for 6 out of 30 Swedish competence centres with strong industry involvement. In 1997, the Chalmers School of Entrepreneurship (the first of its kind in Sweden) was launched. A recent Chalmer's graduate is twice as likely as his/her Professor to start a business within three years of graduation. Between 1997-2012 about 50 companies were created in which former students work as CEOs or hold other key positions. The Chalmers approach shows a strength of a two-sided market for entrepreneurial talent and inventions and allowing students and university inventors match up to commercialise university inventions might be a good alternative to traditional governance. In contrast to other HEIs in Sweden, Chalmers has benefited from its long-term commitment to alumni relations and fundraising campaigns.

Source: OECD (2013) Reviews of Innovation Systems: Sweden.

Mondragon University (ES). Based in the autonomous community of the Basque Country in Spain, Mondragon University (Mondragon Unibertsitatea) is a private non-elitist industry-facing university and a cooperative member of the Mondragon Corporation. It is the smallest of the three universities in the Basque Country with 4 000 students distributed in eight campuses in the provinces of Gipuzkoa and Bizkaia, but punches above its weight in regional development and industry collaboration. Mondragon offers undergraduate degree programmes in Engineering, Business, Education, Humanities and

Gastronomic Sciences in the Basque Culinary Centre in San Sebastian (Donostia), renowned for its large number of Michelin star restaurant. Mondragon's demand-led education includes dual studies, learning by doing and soft skills development. All students complete industry-relevant projects each semester and a one-year full-time industrial/research project. 80 % of PhD candidates are funded by companies. Within 3.5 years of their graduation over 90 % of the graduates are either working or studying, with only slight differences among faculties. Nearly a quarter (24 %) are employed in the firm where they completed their final-year project and 90 % remain in the Basque Country. Mondragon University's collaborative research and knowledge transfer model has generated over 300 projects per year, two-thirds funded by industry, making the university the national leader in Spain in terms of the income generated from applied research per academic staff member.

Medium-term technology roadmaps on future technology needs are developed in collaboration with the industry and used to develop projects which are implemented by project teams involving academic staff, PhD candidates and students. Doing "research WITH industry, rather than FOR industry" helps Mondragon University to overcome the risks of the customer-supplier model which many universities implement in their industry collaboration. Mondragon University is also constantly on the lookout for new ideas to improve its education, RDI and engagement approaches which it implements in a systematic manner.

Source: Puukka et al. (2013b) Higher Education in Regional and City Development: The Basque Country, Spain 2013. OECD Publishing.

Puukka J. (2017) Universities and Businesses Building Euroregional Ecosystems. Input paper to Thematic University Business Forum. 18-19th October 2016. San Sebastián. Spain.

5.7.3 Competence Centres in Sweden and the example of CHARMEC

The Swedish Competence Centres Programme (in Swedish: Kompetenscentrum) was initiated in 1993. Since 1995, nearly 30 Competence Centres have been funded under the scheme which was first coordinated by the Swedish National Board for Industrial and Technical Development (NUTEK) and later Vinnova, the Swedish Governmental Agency for Innovation Systems. Each centre status is awarded for the duration of ten years, after which the centre is expected to be self-sustainable. The activities are located in HEIs which also coordinate them. Competence Centres systematically twin industry with HEI research agendas, competence and personnel through close cooperation and project-based mobility in order to solve basic research issues relevant to the innovation. Bringing together HEIs and firms of high international level, these public-private partnerships help steer HEIs' research agendas towards new and industrially relevant areas, build long term university-industry collaboration, and facilitate competence development as well as employment in industry. The evaluations have shown that Competence Centres have generated longer term research and addressed problems of more fundamental nature than the bilateral university-industry research relationships funded by Vinnova. Competence Centres have had significant systemic impact on HEIs, incentivising them to mainstream "competence centre" mechanisms, excelling in third-mission activities.

CHARMEC is a Competence Centre in Railway Mechanics at Chalmers University of Technology which was established in 1995 by an agreement between the university and NUTEK (later Vinnova). The three parties of CHARMEC are: the universities, the Swedish Transport Administration (Trafikverket), and Swedish and international firms in the related fields. VINNOVA's administrative involvement in CHARMEC ceased in June 2006 and its role was taken over by Swedish Transport Administration. CHARMEC's main objective is to improve the quality in railway transportation, and reduce production, maintenance, operational and environmental costs through industry-relevant knowledge generation. National and international cooperation with complementary and supporting competences are enhanced. The selection and orientation of the individual research projects are made on the basis of overall assessments of technology, economy, safety and environment. The centre facilitates R&D and competence development in areas that are important in railway mechanics and in which none of the partners has been able to shoulder total responsibility. The scientific quality of research results is assured through international publication, doctoral dissertations and international conferences. Knowledge transfer to industry takes place by means of regular contacts, staff exchanges, seminars, reports, test results and computer programmes, and notably by employment of postgraduates in industry.

Sources: EC. Luukkonen T. Arnold E., Martínez Riera C. (2017c) Mutual Learning Exercise. Evaluation of Complex PPP Programmes in STI. Horizon 2020 Policy Support Facility.

http://www.charmec.chalmers.se

5.7.4 Wind-power industry in Denmark

In many countries wind power has been used on a small scale, for example for pumping ground water in individual farms. In Denmark, small industries evolved to meet this demand; by the 1960s the production also included small wind turbines to generate electricity for remote farms and individual households. In response to the repeated oil crises in the 1970s, the Danish government and parliament made a decision to improve energy security by diversifying the energy sector and moving into renewable energy production. One measure was to stimulate the demand for electricity produced by wind turbines. This was done e.g. by requesting energy suppliers to link wind turbines to the electricity grid, and to buy excess electricity from individual producers at concessionary rates. These measures acted as an incentive to the industry to invest in new technology often imported from abroad, as was the case with wind technology from TU Delft in the Netherlands. New materials were also applied (e.g. fibre-materials for wings). Danish research institutes and universities were key players in the wind energy developments, by providing highly skilled workforce, knowledge and expertise and R&D not only in science and engineering, but also in economics, political science, environmental studies etc. The new technology facilitated diversification and strengthening of the Danish farming sector too. The larger wind turbines enabled individual farmers to establish their own small wind farm and sell not only meat, but also electricity. Many wind farms are owned by entire villages or cooperatives.

After a series of mergers and consolidation into larger and stronger businesses, Denmark boasts a world-leading wind industry with hundreds of companies covering every aspect of the supply chain. Some of the original Danish companies are transnationals (e.g. Siemens Windpower), while others are still majority Danish (e.g. Vestas). The wind industry supplies wind turbines and technology across the world and Danish technology is involved in all off-shore wind farms in the world. Extensive research and development programmes into new wind technology are being carried out, both at the company's R&D departments and Danish and international universities. The wind industry employs many thousands of people in Denmark and worldwide in a wide range of supporting sectors. In 2015, over 31 000 people were employed in the Danish wind industry.

Currently wind power generates a major share of electricity in Denmark. In 2015, more than 40 % of Denmark's energy supply came from wind power. The plan is to reach 50 % by 2020, as set out in the 2012 Energy Act. In 2050, Denmark aims to be 100 % free of fossil fuel, with wind energy making up a very large part of the energy mix.

Sources: Danish Wind Industry Association, Vestas Wind Systems, Siemens Wind Power, DONG Energy - http://denmark.dk/en/green-living/wind-energy/ ; http://www.windpower.org/en/knowledge/statistics/industry_statistics.html

5.7.5 The Norwegian tax credit

The Norwegian tax credit (SkatteFUNN) is project based. An application for approval of the project as R&D must be submitted to the Research Council of Norway (RCN). The RCN assesses whether the project falls under the definition of R&D in the tax law for which activities can be accepted as part of the R&D process. Approvals are usually given for 2-3 years. Projects that have not been given ex-ante approval do not qualify for the tax incentive. However, approval has a retroactive effect for R&D that has already taken place in the year of approval.

The company claims the tax credit for R&D costs incurred during the tax year when filing the tax return for the year. The tax authorities are bound by the decision of the RCN in relation to what is regarded as an R&D project and R&D activities. The tax authorities decide which costs are eligible and sufficiently documented, and then calculate the tax credit. The auditor must confirm that the claim being made is correct.

The Norwegian system is an ex-ante approval of what is regarded as R&D and an ex-post approval of the eligible costs. There are very few appeals, and to date no approval case has been brought to court. The ex-ante approval procedure has clear deadlines for approval giving a greater predictability to the process. The Norwegian system also allows the possibility to explore the synergies between R&D tax credits and R&D grants schemes.

Source: EC (2016d) Mutual Learning Exercise "Administration and Monitoring of R&D tax incentives". Horizon 2020 Policy Support Facility, Directorate-General for Research & Innovation;https://rio.jrc.ec.europa.eu/sites/default/files/report/KI-AX-16-009-EN-N_MLE%20tax%20incentives%2015022017_0.pdf

6 INTERNATIONALISATION

6.1 Internationalisation imperative

Poland's HE, science and innovation can become successful only if they are closely linked to and embedded in international knowledge networks. This is because access to new knowledge, technologies and know-how generated and developed outside national borders plays a crucial role in successful innovation. With only 0.4 % of global research in country, Poland risks being left on the periphery of the global knowledge exchange structure if it does not prioritise participation in international networks (see also Kamalski and Plume 2013). Poland needs to compete with other countries to attract and retain knowledge-intensive investments and talents in an increasingly globalised world. In order to address the "Grand Challenges" whose scale and scope extend beyond national borders, it also needs to actively participate in international agenda-setting and coordinated actions.

This chapter analyses the three key indicators which highlight the internationalisation of HE and science in Poland: internationally excellent science, international mobility and talent attraction and international research collaboration. These indicators reflect the international culture within higher education institutions and other public research organisations. **An open international culture needs to be embedded in institutions' promotion schemes, especially in avoiding academic inbreeding. The university administration is responsible for backing international culture by mainstreaming it within the institution.**

6.2 Internationally excellent science

In research and innovation, Poland, underperforms compared to the EU average. This is manifested in Horizon 2020, the key funding programme for internationally excellent research, where Poland is a net payer: Poland receives only 0.9 % out of all funds granted by Horizon 2020, but contributes 3.03 % to to the overall budget (average 2014-2015). The balance is especially skewed with respect to the European Research Council which supports excellence in frontier research in all fields: Between 2014 and 2017, only nine Polish researchers received an ERC grant, which represents just 0.2 % of all ERC grants. See the table 7. "Poland – HORIZON 2020". (For more information see table 2 in Chapter Two). At the same time, Poland is the biggest beneficiary of the European Union. In 2015, mainly due to the role of European Structural and Investment Funds, the total EU spending in Poland amounted to EUR 13.358 billion, while the total Polish contribution to the EU budget reached just EUR 3.718 billion.

Table 7: Poland - HORIZON 2020

	PL total funding in €	**PL funding out of HORIZON 2020**
Horizon 2020 Thereof:	216 956 002	0.9 %
Excellent Science	63 532 467	0.7 %
European Research Council (ERC)	10 437 475	0.2 %
Future and Emerging Technologies	5 778 604	0.8 %
Marie Skłodowska-Curie actions	32 011 694	1.3 %
Research Infrastructures	15 304 693	1.5 %
Industrial Leadership	55 074 075	1.1 %
Societal Challenges	79 830 338	0.9 %

Source: EC RTD Unit for Analysis and Monitoring of National R&I policies (data from 31 May 2017)

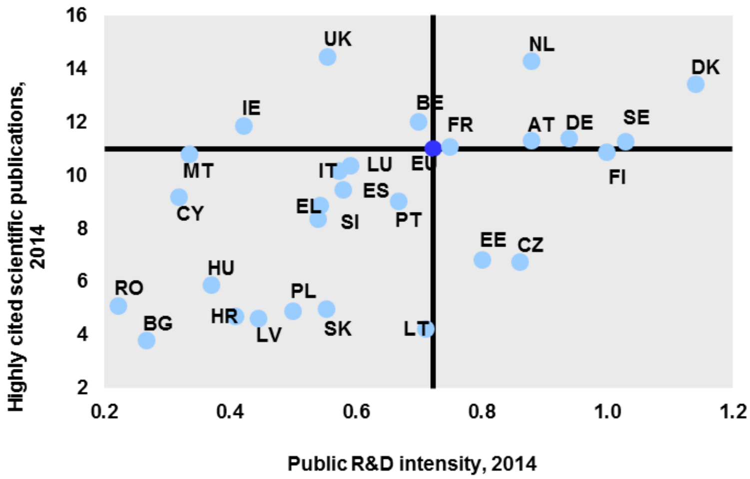
The lack of excellent science is manifested in Poland's limited visibility in global higher education rankings. For example in the Shanghai- (ARWU-) ranking of the world´s 500 leading universities, only two institutions are listed in the category 401 to 500: the Jagiellonian University with 10.3 out of 100 points, and the University of Warsaw with 15.4 points. Five universities and PROs (AGH University of Sciences, University of Warsaw, Warsaw University of Technology, Jagiellonian University and the Polish Academy of Sciences) show positive growth in output and citation impact, with performance matching the world average, but 64 % of Poland's active researchers have only published with an affiliation within Poland and two-thirds of Polish researchers show no signs of mobility (Kamalski et al., 2016).[68]

Compared with other countries with a low public R&D intensity, Poland performs poorly concerning highly-cited publications, see figures 25. and 26 below. Only 5 % of Poland's publications are among the top-10 % most cited publications worldwide (2014), compared to the EU average of 10.6 % (EC 2017b). This means that about 95 % of Poland´s publications do not appear among the top most cited publications in the world. Poland's Government has recognised this gap and aims to improve this situation by moving the scientific

68 Poland has also one of the largest percentages of single author publications globally (Komalski et al. 2016.).

evaluation focus from the quantity to the quality of publications, taking account of international publications, in line with the EU initiatives such as the Pact for Horizon 2020.

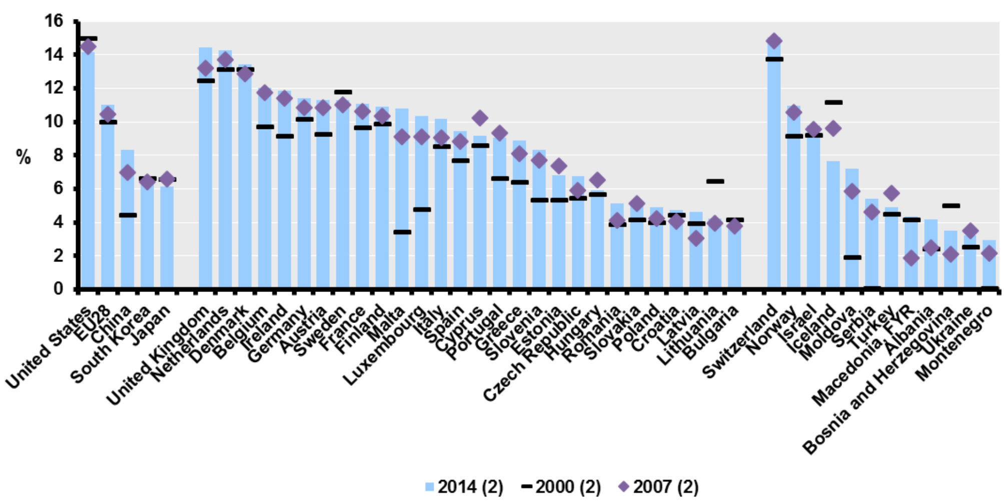
Figure 25: Highly-cited publications vs. public R&D intensity



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: CWTS based on Web of Science database
Note: (1) Scientific publications within the 10 % most cited scientific publications worldwide as percentage of total scientific publications of the country. Fractional counting method. Citation window: publication year plus two years.

Figure 26: Highly cited scientific publications (1), 2000, 2007 and 2014

Scientific publications within the 10 % most cited scientific publications worldwide as percentage of total scientific publications of the country



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: CWTS based on Web of Science database
Note: (1) Fractional counting method. (2) Citation window: publication year plus two years.

6.3 International mobility and talent attraction

International mobility of highly skilled individuals, from students to scientists, is a major driver of knowledge circulation worldwide and boosts excellent research outputs, scientific impact and international research collaboration. The mobility of advanced human capital is one of the most important factors for successful insertion into the global knowledge exchange system (Thorn and Holm-Nielsen, 2008). Kamalski and Plume (2013) show that countries with high percentages of sedentary researchers belong to the periphery of the global knowledge exchange structure, and need to strive to become active partners in the global brain circulation system.

Erasmus+ has given a major boost to the international mobility of Polish students and staff, with Poland performing above the EU average (see the table 8. "Poland – ERASMUS+"). During the period 1998-2014, over 155 000 Polish students participated in Erasmus programmes, while about 68 000 Erasmus students came to Poland. Poland is also among top EU countries which extensively utilises mobility opportunities for academic teachers under the Erasmus+. In the years 2013-2014 Poland sent more university staff and faculty abroad than any other EU country (European Commission 2015), and ranked fifth in the list of countries hosting teachers (European Commission 2015). While mobility has grown, an imbalance remains, with outward mobility exceeding inward mobility.

Table 8: Poland - ERASMUS+ 2014-2015

	PL in absolute numbers 2014/15	PL in % of total 2014/15	Total (33 countries) 2014/15	PL in absolute numbers 2015/16	PL in % of total 2015/16	Total (33 countries) 2015/16
Outgoing (EU): Mobility of students for study	10 934	5.1	213 879	11 283	5.4	206 413
Outgoing (EU) students for traineeship	5 433	7.4	73 338	5 710	7.3	77 736
Incoming (EU) Students mobility	13 101	4.5	291 383	No data available	No data available	No data available
Staff mobility for teaching (EU)	4 098	11.6	35 186	4 606	13.3	34 624
Staff mobility for training (EU)	2 686	14.1	18 990	3 196	15.2	21 026
Incoming (global) student mobility*				1 059	9.1	11 674

Incoming (global) staff mobility*				917	11.6	7 889
Outgoing (global) student mobility*				276	7.9	3 496
Outgoing (global) staff mobility				423	8.1	5 223

* The Global mobility activity started in 2015. It offers mobility beyond Erasmus programme countries to partner countries around the world.
Source: EC (2015b), ERASMUS+ Programme, Annual Report 2014, 2015 Annex 1

Poland features high mobility of doctorate holders in contrast to the rest of the EU, where significant outflows of PhD holders are usually linked to a higher-quality research and innovation system (Germany and Denmark) (EC 2016b). Interviews showed that the international mobility of Polish doctorate holders indicates a higher career instability. The government and institutions could further encourage the mobility of PhD graduates (either in another university in Poland or abroad) for a couple of years after PhD graduation before they can be hired in the same university from which they graduated.

It is important to continue efforts to change the academic culture and also take measures that ensure that the outflows are at least partly offset by inflows of doctorate holders. Talent attraction of foreign students and researchers could help enhance Poland's HE and R&I system. Foreign-born individuals are a substantial source of high-quality research and innovation in many countries. For example in France, foreign-born individuals receive the bulk of ERC grants. Foreign-born students and researchers also play an important role in the commercialisation of research in leading centres of research and innovation, such as Silicon Valley.

Strong progress has been made in terms of international student numbers which have increased rapidly from approximately 10 000 international students in 2006 to 57 000 in 2016, making up about 4 % of the student population. More than half the international students (34 000) are from Ukraine, 8 % from Belorussia and 3 % from India. The security situation and Poland's long-term marketing efforts have pushed up the number of Ukrainian students, which doubled from 2013/2014.

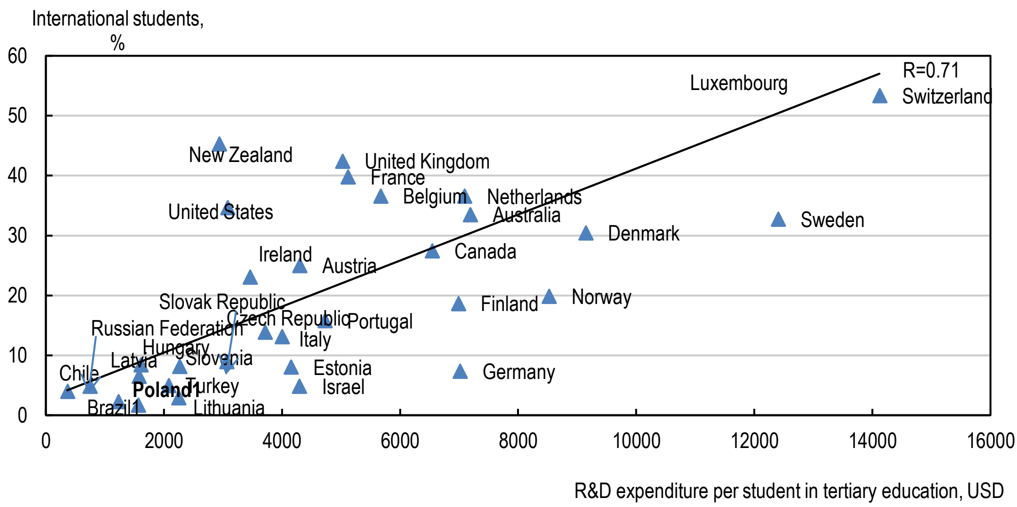
At the same time**, Poland has made only limited progress in attracting foreign-born doctoral candidates or individuals with doctoral degrees.** At 1.7 % Poland also has the lowest share of non-EU doctoral candidates, which stands in stark contrast with the EU average of 25 % (EC 2017b). In the OECD comparison, the share of foreign-born doctorate holders in Poland is very low and slightly declined from 2000/2001 to 2010/2011. Poland had the lowest share out of all 28 countries (for which data is available), while two-thirds of the other 28 countries grew their shares during the same period (OECD 2016c).

The interviews emphasised low remuneration levels and low investment in R&D as key reasons for difficulties in attracting PhD candidates and PhD holders to Poland. Lower salary levels undoubtedly play a role, even if Poland has climbed from having one-tenth to having one-third of the average salary level in Germany. The previous government introduced additional bonuses to scientists employed at HEIs as well as schemes to attract returning Polish scientists or Marie Skłodowska-Curie-like fellowships to foreigners planning to carry out research in Poland (NCN's "POLONEZ" scheme), but the scope of these measures has been limited by uncompetitive funding levels for individual researchers (Klincewicz & Marczewska 2017).

Greater R&D expenditure on higher education could help attract international doctoral candidates to Poland by enhancing the quality of research training, research capacity and the visibility of universities. The OECD data shows (OECD 2016c) that international doctoral students tend to study in countries which make substantial investments in R&D in universities: Poland spends less than USD 1600 per student on R&D in tertiary education and has a very low proportion of international doctoral students, whereas in countries that spend more than USD 5000 in R&D per student in tertiary education international students make up over 30 % of the student body. See Figure 27. below.

Figure 27: Relationship between share of international doctoral candidates and countries' R&D investment in tertiary educational institutions (academic year 2013/14).

International or foreign students as a percentage of total enrolment at the doctoral or equivalent Level and expenditure on R&D per student in tertiary educational institutions.



Source: OECD Education at Glance 2016: OECD indicators. Box Figure B1.a.page 186

However**, investing in the science base will not necessarily improve international attractiveness if other barriers remain. These may range from barriers in the labour market after the completion of a degree (including in the academic career system, habilitation, etc.) to social, legal and cultural factors, and language and visa requirements.**

A cause of concern is xenophobia. For instance, Perspektywy Education Foundation[69] refers to concerns about "ukrainisation" of universities and xenophobic incidents in academic centres. In 2016, Poland's Prosecutor General reported an increase in the number of racially motivated hate crimes in higher education.[70] While the Committee of Rectors has appealed to tackle the hate crime issue in a systematic way, there must be a clear message from the government to condemn these attacks or other hate crimes. While official data from the Ministry of Internal Affairs shows a reduction in xenophobic incidents between 2015 and 2016 from 974 to 851, the government at all levels, the academic community and civil society should develop solutions supporting integration of international students and researchers into the HE and science system and Polish society, and actively fight xenophobia wherever it emerges.

It is also noteworthy that xenophobia is also accompanied by discrimination.[71] Such approaches might induce discriminatory behaviours in a broader context of the HE and science community.

6.4 International research collaboration

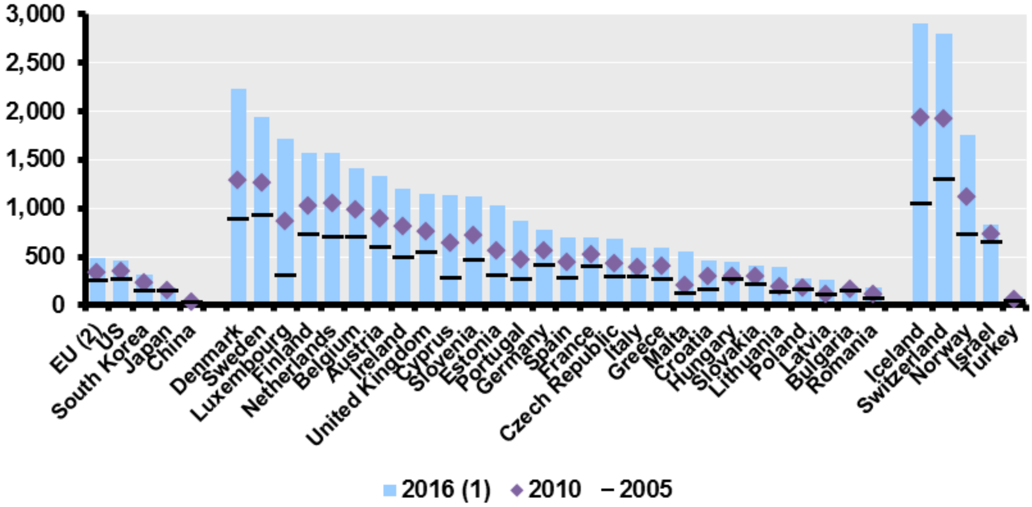
In international research collaboration, Poland's performance shows also room for improvement. According to the EC Collaboration index for all scientific publications and co-publications between 2000 and 2011, Poland reached the third lowest score in the European Union, only marginally above Lithuania and – by a wider margin – Croatia (EC 2014). Poland's international scientific co-publications per million inhabitants grew from 173.6 in 2010 to 254 in 2016, at the level of Latvia, and above Bulgaria and Romania, but clearly lagging behind the EU average of 463. See Figure 28.

[69] http://www.perspektywy.org/index.php?option=com_content&task=view&id=129&Itemid=1

[70] There have been racist attacks on Ukrainian students in Rzeszow in January 2017, Turkish students in Torun in June and October 2016, Turkish, Czech and Slovak students in Bydgoszcz in May 2016, Bulgarian and Turkish student in Bydgoszcz in December 2016, Indian student in Poznan in March 2017, Palestinian student in Lodz in January 2016 etc.

[71] The panel heard of cases when the government representatives were exerting 'soft' influence over HEIs to cancel or organise certain public events, but had remained silent in some cases when it should clearly condemn discriminatory actions.

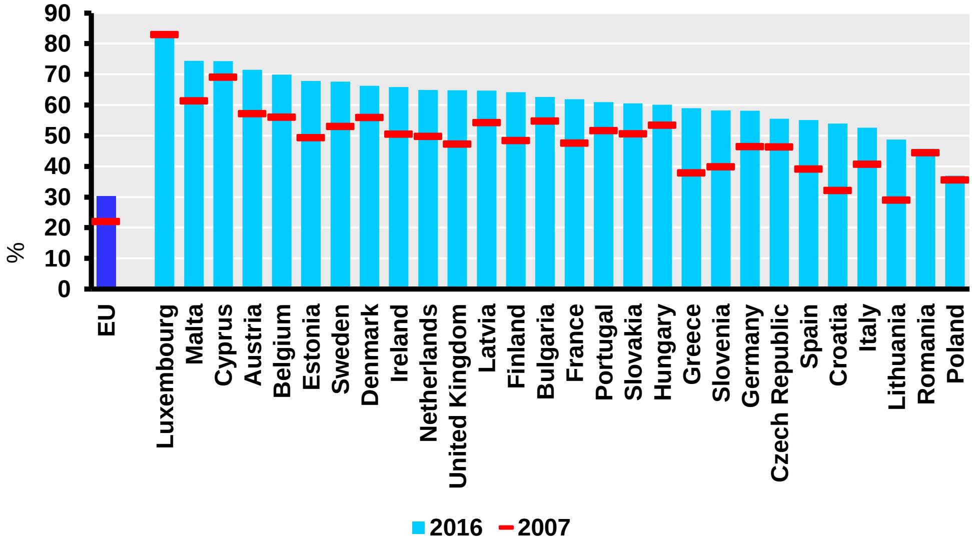
Figure 28: International scientific co-publications per million population, 2005, 2010 and 2016.



Source: DG RTD - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: EIS 2016
Note: (1) US, KR, JP, CN, IL: 2014. (2) EU average includes intra-EU collaborations.

Furthermore, the EC analysis shows that Poland is the worst performing country in the EU in terms of international scientific publications as a percentage of total publications in the country, and has not made progress in this measure since 2007. See Figure 29.

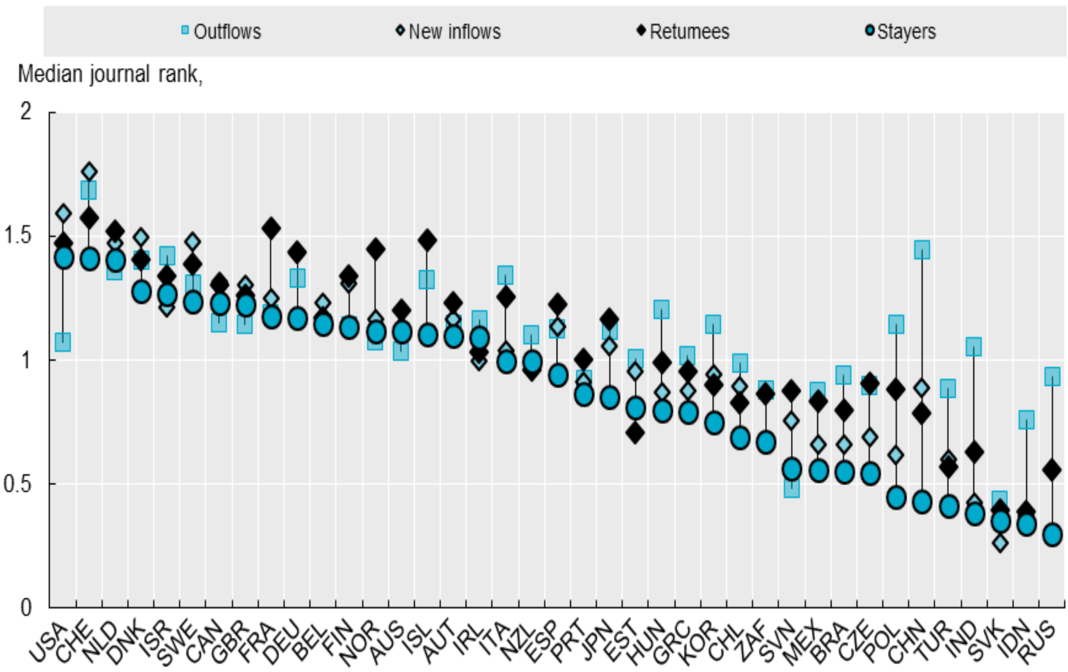
Figure 29 Total international scientific co-publications per country as percentage of total scientific publications per country, 2007 and 2016



Source: DG RTD - Unit for the Analysis and Monitoring of National Research and Innovation Policies
Data: CWTS based on Web of Science database

Researchers with international experience tend to have a higher scientific impact and publish in more prestigious journals, while international co-publications are generally more often cited (EC 2016b). OECD data suggests that with a few exceptions, the "stayers", i.e. those academics who do not change their affiliations, are more likely to publish in lower prestige journals (OECD 2015). The Figure 30 shows that in Poland, internationally mobile researchers and returnees have the highest impact rates among their peers, whereas non-mobile researchers have the lowest impact rates. According to the OECD, the citations of the scientists who move internationally can be up to 20 % higher than those that stay in the same place or country.

Figure 30: Expected citation impact of scientific authors, by mobility profile in 2013. Median Scimago Journal Rank (SJR) scores for 2013



Source: OECD 2016e Figure 3.2.3 OECD calculations based on Scopus Custom Data, Elsevier, version 4.2015; and on Scopus journal title list, accessed May 2015, http://oe.cd/scientometrics, June 2015.
Statlink http://dx.doi.org/10.1787/888933273851

6.5 Internationalisation strategy

The previous Government introduced a programme aimed at increasing the competitiveness of Polish universities in the international market (2015) backed up with EUR 57.5 million to improve the education provision for international students,[72] and encourage universities to seek international accreditations and attract foreign researchers to Poland through the creation of both international doctoral programmes and post-doctoral fellowships.

The current Government has made plans to establish a National Agency for Academic Exchange (Narodowa Agencja Wymiany Akademickiej, NAWA) which will become operational by January 2018. NAWA will be responsible for the international cooperation system to develop a systemic solution to mobility to and from Poland including scholarships and grants and will support universities in their internationalisation efforts.

These plans are commendable and provide a basis for the general opening of Poland's HE, science and innovation system. However, care should be taken to avoid a too narrow focus in the underpinning strategy. A positive development is that Poland has developed a draft for the national ERA Roadmap and plans to have it accepted by the government after the presentation of the draft Law 2.0. This will bring Poland in line with the rest of the EU member states. Internationalisation is an element than needs to be mainstreamed in all HE and science systems rather than a compartmentalised action on mobility. One of the challenges is to ensure that mobility and internationalisation benefits all students and staff, the majority of whom do not take part in mobility schemes. In this respect, the new plans to attract foreign teachers is very welcome as they can help internationalise the curriculum. An overarching national agenda for internationalisation could help move forward. In Germany, a broad-based national internationalisation strategy, which covers higher education, science and innovation, provides a strategic and coordinated approach to international cooperation and linkages. See the Learning Model 7.7.1. on the German Internationalisation Strategy.

6.6 Recommendations on internationalisation

International knowledge flows are critical for Poland as access to new knowledge, technologies and know-how generated and developed outside national borders plays a key role in innovation. Poland needs to actively participate in international HE, research and innovation networks. This requires an open approach to internationalisation and embedding and mainstreaming it in all parts and functions of the system. Important aspects in this respect are: the circulation of foreign and national students and researchers, "internationalisation at home" ensuring that "non-mobile" students also reap the benefits, R&D investment by the government, domestic and international firms, and research performed in Poland by internationally-oriented HEIs and PROs and domestic and foreign firms. In addition, it requires preparing for the changing global landscape of HE

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[72] International education programmes, summer schools, and language training, and encouraged universities to: offer more degree programmes in foreign languages, create joint educational projects

and innovation, and the open innovation models of business firms, which create new opportunities and challenges.

In order to improve internationalisation in higher education and science, the panel suggests the following measures:

Develop a broad-based sustainable strategy for internationalisation.

- **Develop a broad-based internationalisation strategy for Poland that sets out orientations and actions to promote internationalisation, and is mainstreamed in existing policies and programmes.** Such a strategy should provide top-down strategic orientation, while respecting bottom-up activities that will need to support a thriving HE, science and innovation system.

- **As part of the wider internationalisation strategy, develop an explicit national strategy targeted at EU research and innovation, given the growing weight and influence of EU funding in Poland's development.** This strategy is important because Poland should aim at a long-term shift in budgetary returns from the EU. The high dependency on the European Structural and Investment Funds (ESIF) weakens Polish negotiation power in relation to the other EU-28 while a growing share of return from the EU research programmes would strengthen the country's potential for economic and social prosperity. Use the Law 2.0 as a key instrument in exploiting opportunities in international RTI cooperation. The proposal by Radwan et al. acknowledges the current challenges of Polish universities on a global level and provides ideas for change by empowering universities to become key drivers for innovation based on excellent human resources and a culture that celebrates meritocracy over tradition.

- **As the European Research Area will develop into an internal market for knowledge over time, develop a national ERA Roadmap along a set of European-wide priorities.** In doing so, Poland could benefit from experiences in other countries that are working hard to make their systems more absorptive and resilient. In Horizon 2020, and the ERC in particular, Poland could follow the example of other countries in establishing specific measures in order to broaden the number of applicants and support the successful grantees.

Take strong measures to become an active partner in the global brain circulation system.

- **Consider embedding internationalisation in the HE, science and innovation system through a multipronged action:** Ensure that international peer review and evaluations are used at all levels including the evaluation of scientific outcomes, that international experience is a merit in academic career progress, that international publication is prioritised, that multilateral networks of research are fostered and that research groups are launched and led by foreigners to a much larger extent than so far. Where appropriate, make English the standard language for teaching and research. The steps to enhance the internationalisation of the existing faculty could include using international linkages as a key criterion in assessing proposals for granting support for research centres, or further incentives for young researchers to go abroad for their PhD training (or part of it). International orientation should be in the self-interest of autonomous RDI actors. In a HE system where universities provide the best careers, the highest pecuniary rewards and the most prestigious honours are given to those who compete successfully against international peers, there is room for a more restrained role for (central) government.

- **In collaboration with institutions, continue to develop an open, excellent and attractive HE and science system.** While attracting long-term faculty and degree-students from outside Poland is a long-term challenge linked with the ongoing improvement in the quality of the higher education system and economic development, there is significant short-term potential to expand faculty and student exchanges and attract both Polish background and foreign-born scholars and scientists to Poland. Building higher participation in international exchanges should be a priority for the higher education system, with support from the government potentially in the form of faculty grants, student bursaries or financial incentives for institutions. In order to make better use of universities' role in hosting foreign talent, provide good conditions and infrastructure to attract top foreign researchers and students. Examine the successful international recruitment strategies of European countries and top universities as well as their internal support systems and social media campaigns in order to enhance Poland's position in international competition for talent.

- **Encourage institutions to develop a comprehensive internationalisation plan including internationalisation at home, ensuring benefits for all students and staff, not only those who are internationally mobile.** Encourage ways to internationalise the curricula, develop global citizenship skills and ensure that enhanced student and staff mobility will bring more diversity into Polish classrooms. Institutions should also develop programmes to support international engagement at the institutional level across different fields, to overcome the imbalances in engagement across study fields.

- **Encourage and support HEIs to develop more robust administrative offices or centres to support internationalisation.** These centres could be jointly organised with a group of institutions and/or in collaboration with the local/regional authorities. These centres responsible for supporting faculty and students completing exchanges, including assistance to visitors in establishing themselves in the country and transitioning into the Polish education system as well as more substantial support for international research collaboration including H2020.

- **Mobilise the Polish participants in Erasmus+ and the Marie Skłodowska-Curie Actions of HORIZON 2020 (where Poland is relatively successful in comparison with excellence funding) as a potentially valuable pool of change agents.** As the agents of change are often young, open-minded, flexible and internationally mobile individuals, the participants in the EU mobility programmes should be encouraged to continue to share experiences with like-minded people from other parts of Europe or the rest of the world.

Develop broad policies to internationalise Poland's labour market and education system and address discrimination and xenophobia.

- **In collaboration with the national authorities, HEIs and stakeholders, develop broad policies to internationalise Poland's labour market and education system.** Facilitate the integration of international students and employees into the education and labour market. Improve the recognition of foreign diplomats and increase flexibility in employment contracts to enable recruitment from abroad. Continue and enhance talent attraction programmes. Develop a process to expedite the procedure for acquisition of visa and work contracts for foreign nationals who join the HE and science sector. Allow international students to work part time to facilitate their transition to the workforce and relax immigration policies to encourage international students to remain in Poland. Consider relaxing the Polish language policy requirements in education, science and labour market programmes.

- **Set an example for a positive attitude towards internationalisation, by strengthening the dialogue between national ministries and international institutions and experts.** International open orientation is a horizontal feature embedded in a mature and well-functioning HE, research and innovation system, and more of an attitude than an activity.

- **Develop active measures in collaboration with the academic community and civil society to support integration of international students and researchers into the HE and science system and Polish society and address discrimination and xenophobia wherever it emerges.**

6.7 Learning Model

6.7.1 The German Internationalisation Strategy

Nearly 10 years ago, Germany formulated a comprehensive strategy for the internationalisation of research. Based on the strategy, national measures have been taken to strengthen the foundations for internationalisation. The German ministry in charge has adopted a broad, inclusive approach as regards actors and types of collaboration and has worked towards a coherent government policy. The strategy addresses ambitions for international excellence ranging from higher education to academic mobility, to the creation of critical mass, to playing an important role in global/multinational infrastructures, as well as collaboration with developing countries and addressing grand challenges.

The strategy has four main pillars:

- To enhance research cooperation with the world's best, as 90 % of knowledge is created outside of Germany and acquiring this requires international collaboration.
- To open up the international innovation potential of German firms, internationalisation needs to be embedded in funding programmes and targeted activities.
- To strengthen long-term cooperation with developing countries in education, research and development. Support the build-up of foundations for

innovation and education, and to help retain local talent, particularly in Africa.

- To take on international responsibility and overcome global challenges. Focus on grand challenges and on international institutions.

In contrast to other countries' internationalisation efforts, the German approach has some unique features:

- It allows for long-term planning and helps co-ordinate strategies to prevent fragmentation of internationalisation activities. It sends a clear signal to partner countries where Germany is heading internationally.
- It includes 15 target indicators (or dimensions) of internationalisation for the four pillars. Nearly all are quantifiable and many have quantitative goals.
- It addresses national reform processes, e.g. changing governance structures and forms of HE funding to raise the attractiveness of German universities as teaching and research locations.
- It has been backed up with additional public funds.
- It is linked to other major strategies relating to R&D and innovation, including the Excellence Initiative and foreign policy strategies.
- EU research and innovation policy is an important goal that is embedded in larger bilateral, multilateral, regional and global settings. Germany aims to become a motor of European strategy development in RTD.

Source: OECD (2013) OECD reviews of Innovation Policies. Sweden

7 ANNEX: NATIONAL SCIENCE EVALUATION SYSTEM SEDN

During 2009-2012, Poland developed a national science evaluation system (SEDN) for academic units based on big data validation and analysis which generated multi-dimensional, cross-referenced reports available for multiple purposes, was based on close to 1 million science-related validated 'events' including the counts of publications, patents, basic research projects (grants), R&D projects (grants), arts achievements; cooperation with the environment, academic activities, promotions etc. and other achievements of 960 academic units. The system matched data from different databases of HEIs and PROs, national authorities (POL-on) and Thomson Reuters. The assessment was based on the data gathering from multiple resources, automatic validation and computerised parametrisation as well as judgements of 160 evaluation committee experts of KEJN and the final evaluation.

SEDN and the parametrisation of scientific outputs was established as a public-private partnership between the MNiSW and a private firm[73] in consultation with the HE sector and the evaluation authorities. The aim was to develop a continuous process of reporting scientific events, provide tools for evidence-based decision making, enhance the articulation of the goals of national scientific policy, improve the efficiency of the higher education sector in terms of scientific output, and improve quality. The result is one of the world's most comprehensive and complete digital model of science on a country level, which highlights a diverse set of outputs. The majority of the outputs ('events') are reported by all Polish scientific units in at least half-year periods. The number of publications in JCR scientific journals has tripled in 2015 compared with 2011.

The parametrisation of the HEI outputs in Poland

The main idea was to generalise all activities of the academic staff into limited number of specific "evaluation/scientific events" which were divided into three groups: (i) Scientific output (publications, patents), (ii) Scientific potential (scientific projects, laboratories, promotion, certifications, acknowledgements etc.); and (iii) Material effects of scientific activities (cooperating with environment, i.e. research sold, spin-offs, income generated by R&D activities). In addition, a fourth group was created for all scientific units to present their (self-declared) ten most important achievements for the peer evaluation by national experts appointed by KEJN with impact as the guideline for this criterion.

The parametrisation began in 2013 by gathering the data and making assumptions on impact. In the case of publications, points were directly linked with the impact of a journal based on Hi-2 distribution. Consequently, a publication in Nature was automatically awarded 50 points, publication in a journal with IF=0.73 was awarded 15 points, and a publication in a Polish journal with no citation index was awarded 1 to 10 points depending on the journal's parametric evaluation. Projects receive more points in a matrix of project value, internationalisation level and the role of evaluated unit (participant, leader, leader of a thematic chapter etc.). International patents gain double points, while a patent which has been commercialised

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[73] Index Copernicus International

internationally gets quadruple points. For applications, the number of points is based on the scope of application (local, regional, national, international) and its range (influence) must be confirmed by beneficiary (e.g. a company). In terms of ‘Research sold’ both the units income and the income of a buyer who implemented the research output are analysed. For ‘Arts achievements’, awards in international artistic summits (biennale etc.) are covered.

Depending on the “field of knowledge” (technical, life sciences, social sciences and humanities, arts) and the type of the scientific unit (university, research institute, institutes of the PAN, etc.) different wages (multipliers) were adopted in order to match with the unit’s characteristics. In science and health, publications generated 60-70 % of total evaluation points, in technical fields 40-60 %. The fourth group produced up to 10 % of total evaluation points.

The scientific events from the period of 2009 to 2012 (four years) were collected and validated for the first time in 2013. Since the beginning of 2013 most of the events have been reported every quarter or half-year to the national database. Most events are reported by all Polish scientific units at least in half-year periods. In March 2017, the new parametrisation began: all reported events were automatically fed into an evaluation query, but scientific units could make corrections.

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9 LIST OF ACRONYMS

Acronym	Explanation
ANR	L'Agence nationale de la recherche, French National Research Agency
ARP	Industrial Development Agency, Poland
ARWU	Academic Ranking of World Universities
BERD	Business Expenditures on Research and Development
CEO	Chief Executive Officer
CFS-STAT	Federal Cooperation Commission on Statistics, Belgium
CHEPS	Centre for Higher Education Policy Studies, University of Twente
CISTP	Centre for International Technology Policy, George Washington University
CIS-CFS	CIS (International cooperaton commission) and CFS (federal cooperation commission) are two permanent commissions for policy coordination in Belgium
CNRS	Le Centre national de la recherche scientifique, French National Centre for Scientific Research
COSME	EU programme for the Competitiveness of Enterprises and Small and Medium-sized Enterprises
CREST	currently ERAC
DFG	Deutsche Forschungsgemeinschaft DFG, German Research Foundation
DHBW	Dual Hochschule Baden-Wurttenmberg, Dual University DHBW
DHGE	Dual Hochschule Gera-Eisenach
DG EAC	Directorate-General for Education & Culture, European Commission
DG RTD	Directorate-General for Research & Innovation, European Commission
DKK	Danish national currency, krone
EC	European Commission
EIESP	European Institute of Education and Social Policy
EPFL	Ecole Polytechnique Federale de Lausanne
EQAR	European Quality Assurance Register for Higher Education
ERA	European Research Area
ERAC	European Research Area Committee, formerly CREST
ERAB	European Research Area Board
ERC	European Research Council
ESIF	European Structural and Investment Funds
EIS	European Innovation Scoreboard
ET	Education and Training
ETS	Educational Testing Service
ET2020	Education and Training 2020
EU	European Union
EU-28	28 member states of the European Union
EUA	European University Association
EURAB	Europea Research Advisory Board
€	Euro
FDI	Foreign Direct Investment
FFG	Austrian Research Promotion Agency
FNP	The Foundation for Polish Science
FP7	7TH Framework Programme, European Union's Research and Innovation

Acronym	Explanation
	funding programme for 2007-2013
FTE	Full Time Equivalent
GBARD	Government Budget Appropriations or Outlays on R&D (currently used abbreviation)
GBAORD	Government Budget Appropriations or Outlays on R&D
GBP	Great Britain Pound
GDP	Gross Domestic Product
GERD	Gross Expenditures on Research and Development
GUS	Central Statistics Office of Poland
HE	Higher Education
HE-BCI	Higher Education and Business and the Community Integration Survey (UK)
HEFCE	Higher Education Funding Council for England
HEI	Higher Education Institution
HEIF	Higher Education Innovation Fund (UK)
HERD	Higher Education R&D Expenditure
H2020	Horizon 2020
IB	Research Institute, Poland
ICT	Information and Communication Technologies
IP	Intellectual Property
IPR	Intellectual Property Right
ISCED	International Standard Classification of Education developed by UNESCO
ISCED-F 2013	2013 fields of education and training in ISCED
KEJN	Committee for Evaluation of Scientific Units, Poland
KFK	National Capital Funds, Poland
KPN	Committee for Science Policy, Poland
KRASP	Conference of Rectors of Academic Schools in Poland
KRD	National Representation of Doctoral Students, Poland
KRePSZ	Conference of Rectors of Public Schools of Higher Vocational Education, Poland
KRPUT	Conference of Rectors of Polish Technological Universities
KRUP	Conference of Rectors of Polish Universities
MIOIR	Manchester Institute for Innovation Research
MIT	Massachusetts Institute of Technology
MNiSW	Ministry of Science and Higher Education, Poland
MR	Ministry of Economic Development, Poland
NAWA	National Agency for Academic Exchange, Poland (to be launched in 2018)
NCBiR	National Centre for Research and Development, Poland
NCN	National Science Centre, Poland (funding agency for fundamental research)
NFOSiGW	National Fund for Environmental Protection and Water management, Poland
NIT	National Institute of Technology, Poland
NRDN	National Council for Scientific Excellence, proposed by Radawn et al. 2017
NUTEK	Swedish National Board for Industrial and Technical Development
NYC	New York City
OECD	Organisation for Economic Co-operation and Development
OECD CSTP	OECD Committee for Scientific and Technological Policy
OECD	OECD Working Group of National Experts on Science and Technology Indicators

Acronym	Explanation
NESTI	
OECD TIP	OECD Working Group on Innovation and Technology Policy
OMC	Open Method of Coordination
OPI	Data processing institute of MNiSW
PAN	Polish Academy of Sciences
PARP	Polish Agency for Enterprise Development
PCT	The International Patent System. The Patent Cooperation Treaty
PFR	Polish Development Fund
PhD	Doctor of Philosophy
PIAAC	OECD Survey of Adult Skills
PISA	Programme for International Student Assessment, OECD
PKA	The Polish Accreditation Committee
PLN	Polish national currency (zloty)
POL-on	Statistical system of the MNiSW
PoP	Professor of Practice
PRO	Public Research Organisation
PSF	Policy Support Facility
PWSZ	Higher Vocational School, Poland
RCN	Research Council in Norway
RGIB	The Main Council of Research Institutes, Poland
R&I	Research and Innovation
RIO	Regional Innovation Observatory
R&D	Research and Development
RDI	Research, Development and Innovation
RGNiSW	Central Council of Science and Higher Education, Poland
RPA	Regional Patent Agency
RTDI	Research, Technology, Development and Innovation
SATT	Technology Transfer Acceleration Company, France
SDC	Sino-Danish Centre
SEDN	National Science Evaluation System, Poland
SEK	Swedish national currency, Krona
SME	Small and Medium-sized Organisation
STEM	Science, Technology, Engineering and Mathematics
STI	Science, Technology and Innovation
TTA	Technology Transfer Alliance
TTC	Technology Trancer Centre
TTO	Technology Transfer Office
UAS	University of Applied Sciences
UPAS	University of Polish Academy of Sciences (suggested by the Academy)
VC	Venture Capital
VET	Vocational Education and Training
VINNOVA	The Swedish Governmental Agency for Innovation Systems
ZSI	The Centre for Social Innovation, Centre for Social Innovation

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A ‘Policy Support Facility’ (PSF) has been set up by the Directorate-General for Research & Innovation (DG RTD) of the European Commission under the European Framework Programme for Research & Innovation ‘Horizon 2020’, in order to support Member States and associated countries in reforming their national science, technology and innovation systems.

The Peer Review of Poland's Higher Education and Science system was carried out between January and September 2017 by a dedicated PSF Panel, consisting of eight independent experts and national peers.

The report outlines the rationale behind the policy messages proposed by the PSF panel to redress Poland’s Higher Education and Science system’s structural weaknesses and build on its existing and potential strengths. To develop these messages and numerous operational recommendations, the review team has taken advantage of its expertise on higher education and R&I policy formulation, implementation and evaluation and good practice applied in the Member States and OECD countries.

It is the country’s responsibility to ensure the follow-up to the peer review as well as the potential implementation of its recommendations through concrete reforms.

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