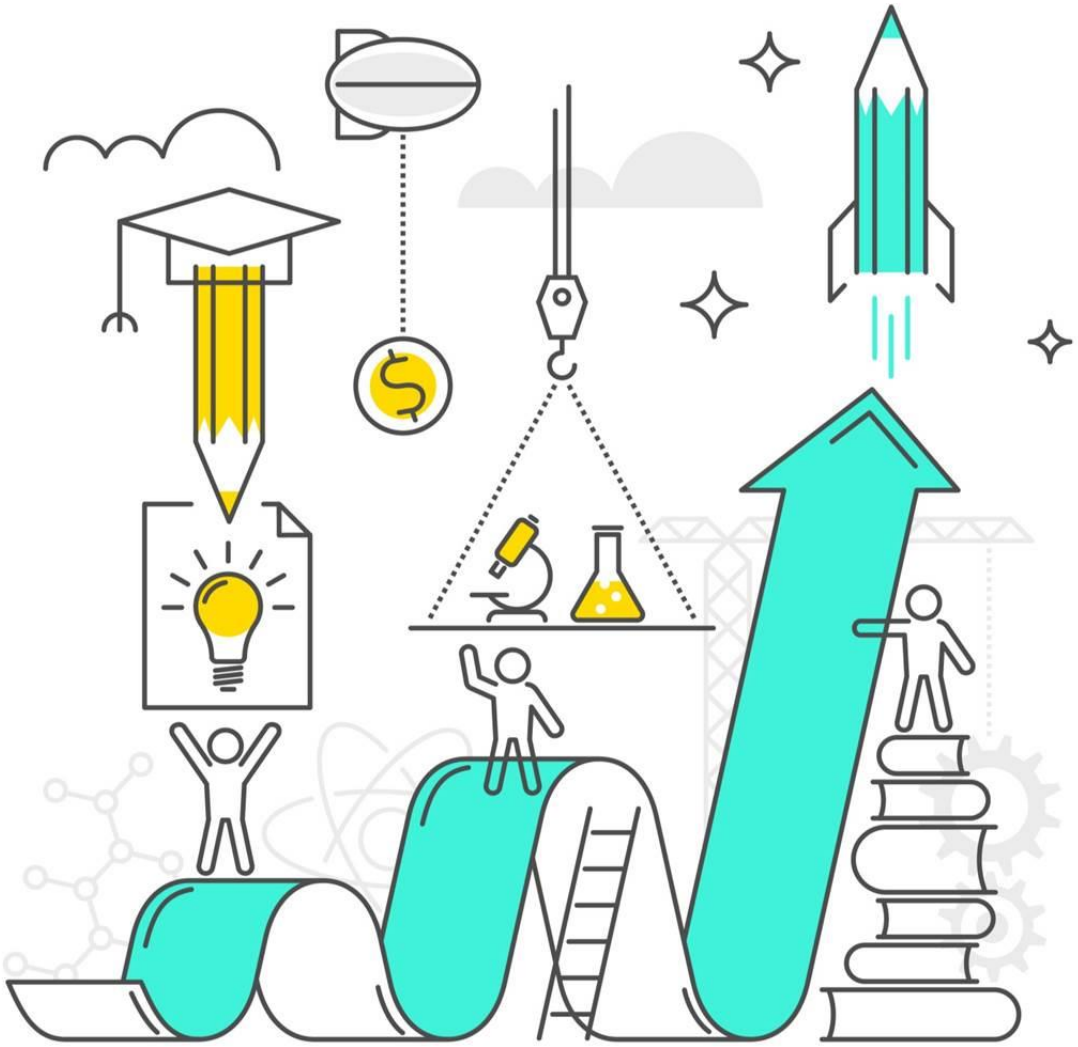
Stimulating knowledge transfer: Challenges and policy responses

Workshop summary

7-8 November 2017

Lisbon



REPÚBLICA PORTUGUESA
CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

FCT
Fundação para a Ciência e a Tecnologia
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OECD

About the workshop

Countries are increasing efforts to stimulate knowledge transfer between universities and the private sector, as a way of fostering innovation-driven growth. While there has been much experimentation in the policy approaches used to enhance science-industry linkages, there is little evidence on what policy instruments and combinations (or policy mixes) are most appropriate.

The workshop "Stimulating knowledge transfer: Challenges and policy responses", which took place in Lisbon on 7-8 November 2017, addressed this issue. Over 50 participants from academia, policy, and industry, and representatives from the OECD Working Party on Innovation and Technology Policy (TIP), gathered to exchange perspectives on knowledge transfer policies and their impacts in different country contexts. The discussions provided important inputs to the ongoing OECD Innovation Policy Review of Portugal and the OECD TIP project on "Assessing the impacts of knowledge transfer and policy" (https://www.innovationpolicyplatform.org/impact).

The workshop was organised around the following four thematic panels:

- Challenges to the stimulation of technology transfer in Portugal
- Science, innovation and knowledge transfer in a diversified higher education landscape
- International and intersectoral mobility of human resources
- Knowledge transfer to 'non-high-tech' industry and services and companies with low absorptive capacities
- What is the right policy mix for Knowledge Transfer?

The workshop also served as an opportunity to discuss how to exploit synergies between the TIP thematic work and the country reviews.

The workshop was organised by Tiago Santos Pereira (FCT), Caroline Paunov (OECD), Philippe Larrue (OECD) and their teams.

The agenda and speakers' presentations are available at:
https://www.innovationpolicyplatform.org/Lisbonworkshop2017

Main messages from the workshop

Changing realities of industry-science collaboration

Industry-science collaboration has moved from the simple transfer of knowledge to creating the right context for the co-creation of knowledge. In Portugal, collaborative laboratories (CoLABs) are a policy initiative to foster large-scale science-industry collaboration in applied research targeted to industrial and societal challenges, based on public-private partnership models with 50% of their funding coming from industry and the remainder from public sources.

As knowledge is embodied in people, a more 'human-centred' approach to knowledge transfer policy that takes into account the needs of the local economy is important. This includes a focus on enhancing the mobility of researchers between industry and research, but also thinking of research fields and skill sets that match those of the local economy and in particular its most dynamic sectors.

The outward mobility of researchers and top talent can weaken national research performance substantially, requiring efforts to build networks with the diaspora. Policy programmes to maintain networks with the diaspora, such as the Knowledge Bridges programme in Greece, can help in that regard.

Different types of intermediary organizations have been created across countries to build bridges between industry and research and create "spaces" for co-creation. This includes different types of public research institutes, such as Fraunhofer (Germany), the Catapult Centres (UK) and Christian Doppler Gesellschaft (CDG) (Austria), but also public-private collaborative laboratories, technology transfer offices, and incubators.

Supporting linkages for all is important

Policies to promote science-industry knowledge transfer should also be addressed to 'non-high-tech' industries and services and take into account the main channels important to knowledge transfer for those sectors. This is important because these sectors have much to gain from linkages with research. Since the channels for knowledge transfer are different across sectors and types of firms, the policy mix to support this type of knowledge transfer is different. Specificities range from supporting the technologies that are most critical to the specific non-high-tech industries to ensuring specialised intermediary institutions are in place.

SMEs and start-ups can also benefit substantially from effective linkage with research to strengthen the diffusion of frontier knowledge across all firms in the economy. They can benefit from active intermediary organizations and industry associations that help build connections. Striving towards simple and easy ways to link with research are often important to allow for such connections to be set up.

The policy mix for knowledge transfer

Public policies to support knowledge transfer operate in an increasingly complex context with a diversity of institutions, including diversified higher education institutions, public research laboratories and new types of intermediary organizations enrich the higher education landscape. The incentives set for different actors and their responsibilities are important to take into account in the new context. The funding model of intermediary institutions, for instance, affects the business model they will adopt and their positioning vis-à-vis industry players. Greater levels of autonomy for universities will also affect incentives. The increasing level of autonomy given to universities also has impacts.

The key challenge of policy is to have policy instruments work together in a synergistic way within a coherent policy mix. This includes ensuring effective co-ordination of support provided at regional, national and supra-national levels and providing joint spaces for interaction among actors that use the diverse policy instruments. Institutional stability is crucial to guarantee adequate focus.

Levels of support for public research differ also with the level of maturity of linkages. Innovation vouchers and technology extension services are useful instruments to initiate a virtuous circle between the demand for innovation and the offer of innovative solutions in environments where there is a lack of formalised demand for innovation. Where connections already exist, strengthening more formal channels of collaboration for co-creation becomes important, including offering the right regulatory framework for such endeavours.

Building in flexibilities in industry-science collaboration models is important to allow for those collaborations to be responsive to emerging dynamics. The experience of the Austrian Christian Doppler Gesellschaft (CDG) programme, which establishes projects based on an industry challenge and that are no longer than 7 years, is interesting in that regard. The CDG scheme is flexible because it does not establish new legal entities, as CDG laboratories are hosted at universities.

Improving the evidence on the impacts of public research on innovation is also important to guide policy. Similarly there is a need for evaluations of the impacts of different policy instruments that also take into account the impacts of the policy mix.

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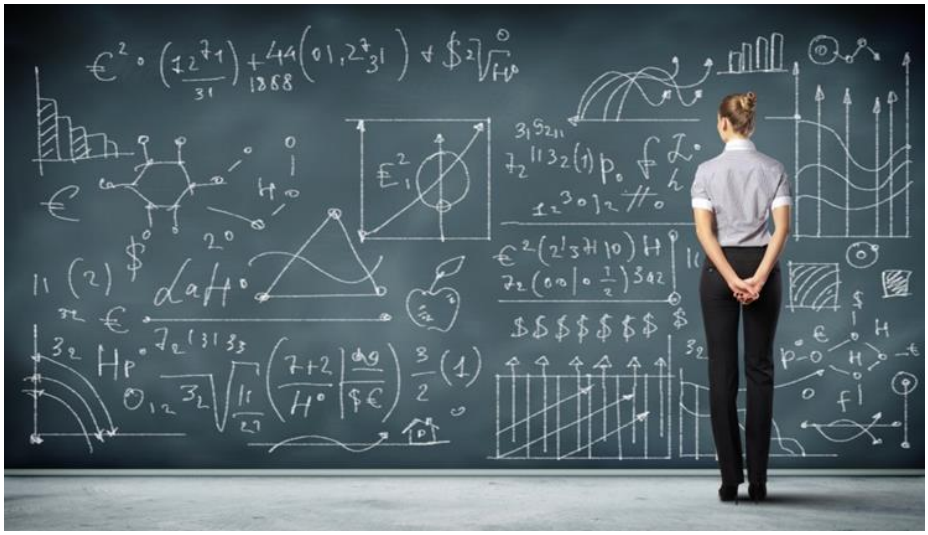
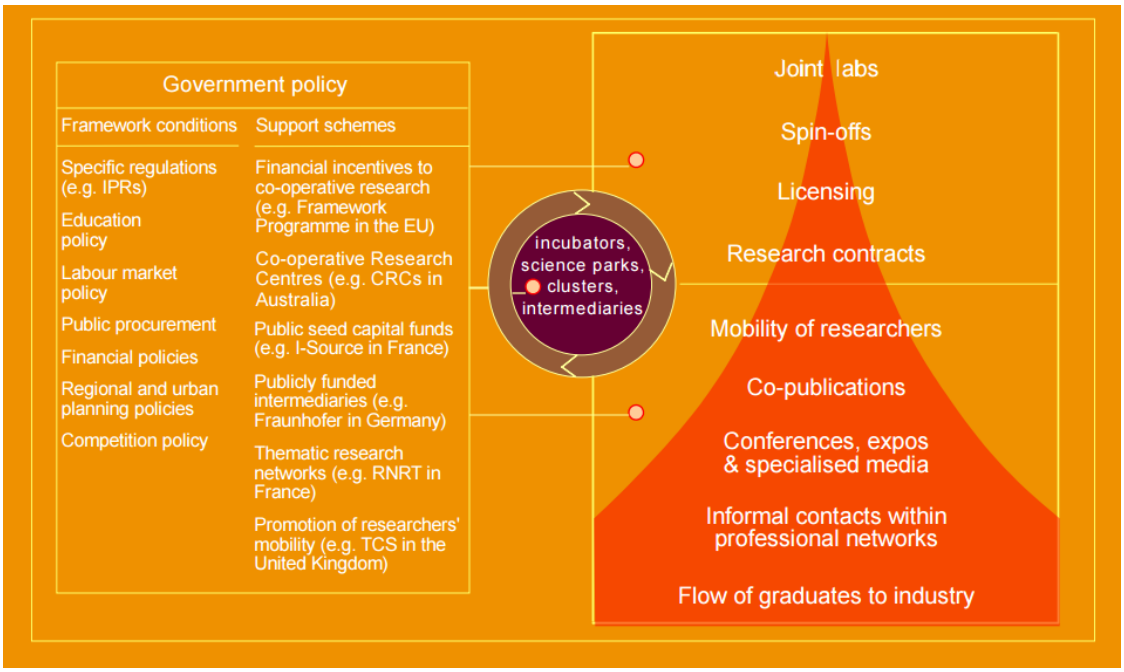


1. Co-operation and co-creation between industry and science in Portugal

Boosting the diffusion of public research has become a major goal of science, technology and innovation policies over the last few decades in OECD countries (OECD, 2013) and Portugal is no exception to this rule. The first sessions of the workshop focused on the diverse Portuguese policy initiatives aiming at fostering co-operation between industry and science and improving the transfer of public research results to society

The session was opened with a keynote presentation by Manuel Heitor, the Minister of Science, Technology and Higher Education of Portugal, who presented an overview of the Portuguese policy mix to support science-industry knowledge transfer, which very much addresses the different types of mechanisms of industry-science linkages as described in the 2003 TIP report on the topic (Figure 1).

Figure 1. Formal mechanisms for industry-science relationships: the tip of an iceberg



Source: Presentation of Manuel Heitor, available here.
Original source: OECD (2003), Turning Science into Business, OECD Publishing, Paris.

Among all policy support mechanisms, he referred in particular to policies aimed at:

1. Enhancing public-private partnerships for knowledge transfer,
2. Support for researchers and PhDs in industry, and
3. Collaboration programmes between Portuguese universities and leading institutions abroad.

These topics are summarized in Box 1.

Box 1 - Opening remarks by Minister Manuel Heitor

Public-private partnerships

- Several intermediary organizations have gained in importance in Portugal.
- Examples include the Centre for Engineering and Product Development (CEiiA), the Institute for Systems and Computer Engineering, Technology and Science (INESC TEC).
- These collaborations have produced successful research collaborations in the area of renewable energy, mobility management and territorial surveillance.

Support for researchers and PhDs in industry

- The absorption of researchers and PhDs in industry is a key challenge that Portugal faces in order to catch up with leading innovation performers.
- Consequently, increasing funding of academic spin-offs is being provided as are other schemes to facilitate opportunities for researchers and PhDs in industry.

Manuel Heitor
Minister for Science, Technology and Higher Education of Portugal

Collaboration programmes between Portuguese universities and leading institutions abroad.

- Portugal has developed key collaborative programs between Portuguese universities and world leading institutions, such as the MIT, Harvard, UT Austin, or Fraunhofer (Figure 2).
- These collaborations aim to internationalize Portuguese universities and bring them closer to frontier research, by learning from best practices of leading institutions. In addition to training and research collaborations, these programmes also involve initiatives that aim to enhance the management of knowledge transfer.
- In line with this focus on human resources, Manuel Heitor also advocated for a more “human-centred” approach to policy design and implementation, which pays more attention to investment in human capital, to the creation of highly skilled employment, and to social mobility and equality of opportunities. He added that this was even more important in the context of the digital transformation.

Figure 2. International collaborations with leading universities

Source: Presentation of Manuel Heitor, available here.

1.1. Knowledge Transfer to Increase Public Research Impact

Speakers in the introductory session of the workshop highlighted two additional topics of importance for policies to promote knowledge transfer:

1. Design of research funding and
2. Importance of matching skills and industry.

Research funding schemes

As for the design of research funding, in line with the need to legitimise public investments in research, Helena Pereira, Vice-President of the Portuguese Foundation for Science and Technology (FTC), stressed how the policy instruments offered by FCT to support knowledge transfer had evolved substantially. While established instruments such as R&D grants remain important, a stronger focus on thematic calls has emerged. She also emphasized the importance of setting incentives for researchers. For this reason, knowledge transfer has become one of the evaluation criteria for the selection of applicants for FCT grants.

> Portugal has increased the emphasis of practice-based research, which has larger has larger potential science-industry linkages - *Helena Pereira*

Dominique Guellec, Head of the Science and Technology Policy Division at the OECD, explained how thematic calls, being mission-oriented, can have higher impact by aligning the research activities of the scientific community with the needs of industry and society.

Mission-oriented calls can also directly focus on addressing major global challenges, such as environmental concerns, the impact of the digital transformation on jobs and well-being, and globalization. These global challenges require rethinking knowledge transfer policies.

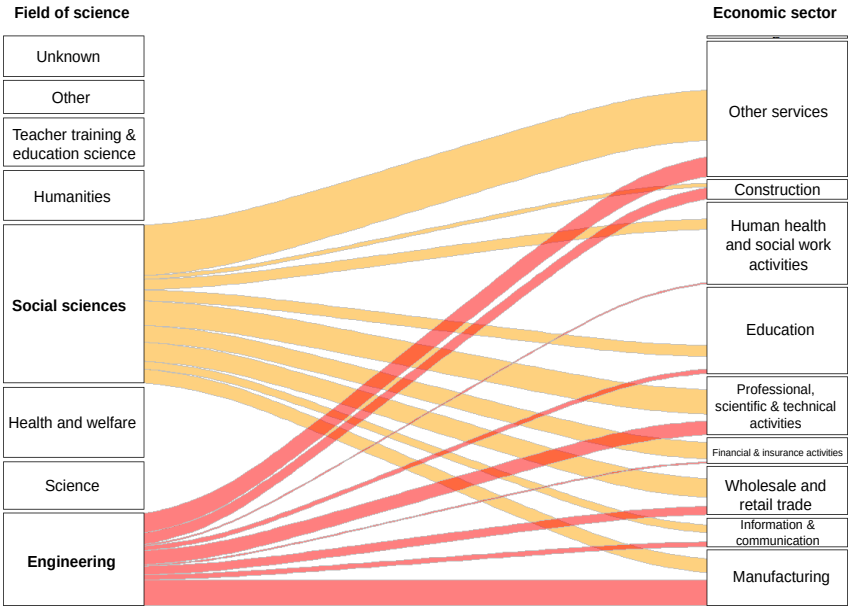
Skills-industry match

Caroline Paunov, Senior Economist at the OECD, stressed that industry structure matters importantly to how knowledge transfer develops. New OECD evidence on student mobility, a key channel of science-industry relations, shows that industries differ substantially in the skillsets they demand (Figure 3) (Paunov, Planes-Satorra and Moriguchi, 2017). Knowledge transfer offers opportunities not only for high-tech industries but also for firms in services and low-tech industries.

Caroline Paunov also highlighted that in all OECD countries diversified higher education landscapes contribute to effective knowledge transfer where a diversity of intermediary institutions act as connectors of researchers and industry. Helena Pereira mentioned with regard to those interactions that the number of collaborative projects between different universities, polytechnics and industries has increased in Portugal.

New policy approaches are necessary to support linkages with science for firms with lower absorptive capacities that tend to remain "below the radar" because these firms have much to benefit from science-based technologies.

Figure 3. Economic sector destinations of graduates in social sciences and engineering, EU-28, 2013



Note: The width of linkages reflects the relative size of connections. Fields of science
Source: Paunov, Planes-Satorra and Moriguchi (2017) based on European Union Labour Force Survey, 2013

She also noted that while countries have experimented with different approaches to support knowledge transfer, a better understanding of how policy mixes work best in different industry and research contexts is needed.

1.2. Challenges to the stimulation of technology transfer in Portugal

In the context of the ongoing work on the OECD Policy Review of Portugal, this session brought together representatives from academia, industry and knowledge intermediaries to discuss knowledge transfer in Portugal.

Phillipe Larrue, Policy Analyst at the OECD, presented some preliminary findings from the ongoing OECD Innovation Policy Review of Portugal (see Box 2). He showed that Portugal has a very efficient system in terms of scientific publications and patents per Euro invested. However, the economic crisis and the financial austerity that followed have severely hit public and private R&D activity.

Box 2 - OECD Innovation Policy Review of Portugal

The main identified challenges regarding science-industry knowledge transfer relate to:

1. Universities' research focus that differs from industry needs,
2. Limited industry demand for research inputs,
3. Regional imbalances, and
4. Fragmentation of the innovation governance system.

These issues were taken up in the session's discussions.

Universities' research orientation

The OECD's analysis points to the importance of directing efforts at making research more mission-oriented in Portugal to directly address industry demands.

Representing a point of view from research centres, Elvira Fortunato, director of a leading research centre at the New University of Lisbon, argued that, in regard to research orientation, the distinction between basic and applied research can be misleading. This is in line with the views of the European Research Council stating that the distinction between basic and applied research is difficult, due to the fact that emerging areas of science and technology often cover substantial elements of both, and both are relevant for knowledge transfer.

Guy Villax, CEO of Hovione - one of the main R&D-investing firms in Portugal that employs over 80 PhDs -, argued that Portuguese universities are handcuffed by public sector budget rules. These rules provide them with insufficient freedom to pay faculty based on merit, and also to use grants from industry as intended by funders. To escape these handcuffs, many universities have created independent legal entities to engage with industry. The increased autonomy of universities in Portugal, he argued, could also facilitate collaboration in the future.

In addition to the current lack of autonomy, Pedro Teixeira, Director of the Centre for Research on Higher Education Policies, added that the higher education system in Portugal is characterized by strong national regulation, high inbreeding and low career mobility. He also expressed concern over a strong academic drift (even in Polytechnics) and lack of recognition for researchers who engage with society. However, he also pointed to recent trends that promise better and more efficient collaboration with industry. These include increasing institutional autonomy, fewer civil service ties, higher valorisation of links with industry and stronger competition among institutions.

Limited industry demand for public research inputs

Portugal's industry structure is characterised by a large share of SMEs that operate in traditional sectors and that have limited demand for public research.

Phillipe Larrue explained that the low demand for highly qualified staff outside the academic sector, and the apparent mismatch between supply and demand, requires considering new policies to facilitate and incentivise employment of highly qualified staff in the private sector. Elvira Fortunato also noted that the creation of job opportunities in industry for PhDs and researchers is critical. She also emphasised the importance of facilitating the circulation of highly skilled PhD students between industry and research.

The creation of collaborative laboratories (CoLABs) partly aims at improving industry collaboration with industry (see Box 1). CoLABs are knowledge intermediaries that are private, non-profit foundations or private companies that integrate activities of research units of higher education institutions, public research laboratories, intermediate organizations, companies, and business associations. José Luis Encarnação, Coordinator of the International Follow-up and Assessment Commission of the CoLABS, presented plans and pointed to the fact that another objective pursued by CoLABS is to fund the creation of highly skilled jobs in industry.

Regional imbalances

Strong regional imbalances are another important challenge. Regions that are less developed face larger challenges in building a research-based innovation system also because encouraging investment for innovation is more difficult. However, they have much to gain from such linkages. The Portuguese polytechnics, located across the different regions of Portugal, play an important role in attending to the needs of these regions (see Box 3).

Box 3 – Regional impact of multinational's R&D centres

José Manuel Mendonça, President of INESC-TEC, presented examples of successful technology transfer between INESC-TEC and companies in the fields of energy, agriculture, shoes, textiles, and machines. Engaging in innovation has helped those firms foster resilience to international competition. He argued that Portuguese firms have to exploit frontier technologies better to compete globally. A positive development in recent years is that foreign multinationals such as Vesta, Altran and Bosch have created new R&D centres in Portugal as they were attracted by the country's pool of highly skilled engineers. Attracting multinationals to less developed areas, he argued, can have a transformative impact in those regions.

Governance system fragmentation

Portugal has a complex and fragmented system of governance of innovation policies, with limited inter-ministerial coordination. In particular, the weak coordination between higher education, research and innovation policies challenges the policy mix in support of innovation.

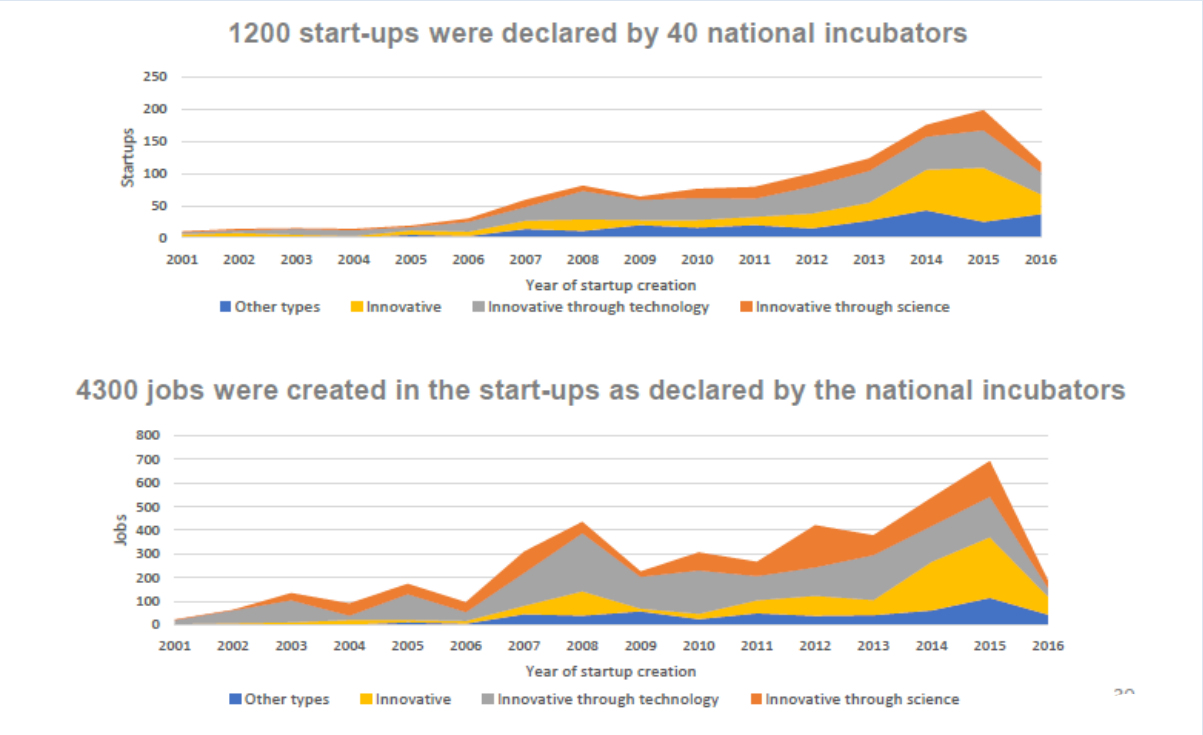
Innovation agencies like the Portuguese National Innovation Agency (ANI) engage in efforts to provide a comprehensive support scheme for innovation, including by supporting knowledge transfer from public research institutions to industry (Box 4).

Box 4 – Role of knowledge intermediaries addressing the gaps in the innovation system

Isabel Caetano, Board Member of ANI, pointed to the importance of continued public support to companies throughout the life cycle of funding programs, and not only at the initial stage. Support programmes targeting SMEs also aim to be user friendly, easy to apply and understand. ANI provides different kinds of grants, including for R&D projects involving collaborations between public research and industry. ANI is also providing support to intermediary infrastructures such as incubators at universities to support start-ups of researchers and students. Since 2001, public funding for incubators has grown, and the number of start-ups that receive support from incubators has increased from less than 50 in 2005 to more than 200 in 2015 (

Figure 4).

Figure 4. Number of start-ups in incubators receiving support from the Portuguese National Innovation Agency (ANI)



Source: Presentation of Isabel Caetano, available here.

2. Science, innovation and knowledge transfer in a diversified higher education landscape

The session focused on different approaches countries have adopted to i) strengthen the capacities of universities for knowledge transfer, and ii) to ensure research responds more to industry needs.

2.1. Strengthening the role of universities in knowledge transfer

Haakon Kobbens, Senior Advisor of the Ministry of Education and Research, gave an overview of the recent reforms of the higher education system in Norway. A key challenge addressed by these reforms was a reduction in the number of universities and research institutes to provide for consolidated education and world-leading research infrastructures of high quality. The government initiated a consolidation process that has resulted in mergers among HEIs reducing their number from 33 in 2003 to 21 in 2017.

In parallel, over the last decade, technology transfer has become a more important objective for universities in Norway. Two reforms are particularly relevant in this regard:

- Since 2003, universities are granted ownership over IP rights from research that was being developed with public funds at universities. Previously researchers had ownership rights.
- The establishment of technology transfer offices (TTOs) in most universities to strengthen their knowledge transfer capacities.

Etienne Choupay, Project Coordinator at the Innovation Division of the Ministry of Economy, Development and Tourism in Chile, gave an overview of Chile's technology transfer ecosystem. He explained that since the country's performance in science-industry collaboration is relatively weak, the country's innovation agency CORFO supports universities' knowledge transfer activities, namely through the creation of two types of organisations:

- University technology transfer offices (TTOs): This started in 2010 with the training of experts on intellectual property and the provision of support for spin-offs. Since then, 29 "in-campus" TTOs have been created.

- "Off-campus" TTOs that complement existing "in-campus" ones: Three "technology transfer hubs" were established at the end of 2016, bringing together 26 universities, 8 technology centres, 4 international centres of excellence, 2 investment funds, and 11 private companies. These newly created off-campus TTOs focus on the international commercialization of Chilean technologies in three priority sectors (agriculture, health, and industrial production and energy).

Eduardo Beira, Coordinator of the Programme for the Modernisation and Valorisation of Polytechnic Higher Education in Portugal, argued that allowing for widespread access to higher education is critical to knowledge transfer. In particular, if HEIs prepare students to conduct "practice-based research" in a collaborative way, then this will increase possibilities for knowledge transfer between science and industry. He also argued that in Portugal, polytechnics are well positioned to provide such training.

An example of such practice-based research is the Demola network, an organisation that facilitates co-creation projects between university students and companies, as explained by Isabel Ferreira, Professor at the Bragança Polytechnic Institute. She also explained that, in Portugal, the strategies followed by universities and polytechnics are different. While universities are guided by global trends and contribute with national endowments to state-of-the-art research (outside-inside-outside model), polytechnics address local challenges, bringing existing technologies from abroad when necessary and adapting them to the local context (inside-outside-inside model).

2.2. Addressing the needs of industry for knowledge transfer

Jari Hyvärinen, Senior Adviser to the Finnish Funding Agency for Innovation (Tekes), provided an overview of Tekes' approach to knowledge transfer. He noted that in Finland public support for science-industry cooperation has become more focused on company needs, following financial cuts for public research funding. Tekes' strategy is to accelerate growth of Finnish companies and help them succeed in international markets.

New approaches to support knowledge transfer include open access policies, thematic calls for digitalisation and global value networks, co-working spaces where entrepreneurs share office space and interact, and innovation competitions or "hackathons".

Moreover, Tekes has established two new funding services to encourage researchers and companies to engage in more active cooperation: the Co-Creation funding (that supports the joint development of a research idea) and the Co-Innovation funding (that supports joint research and technology development) (Figure 5).

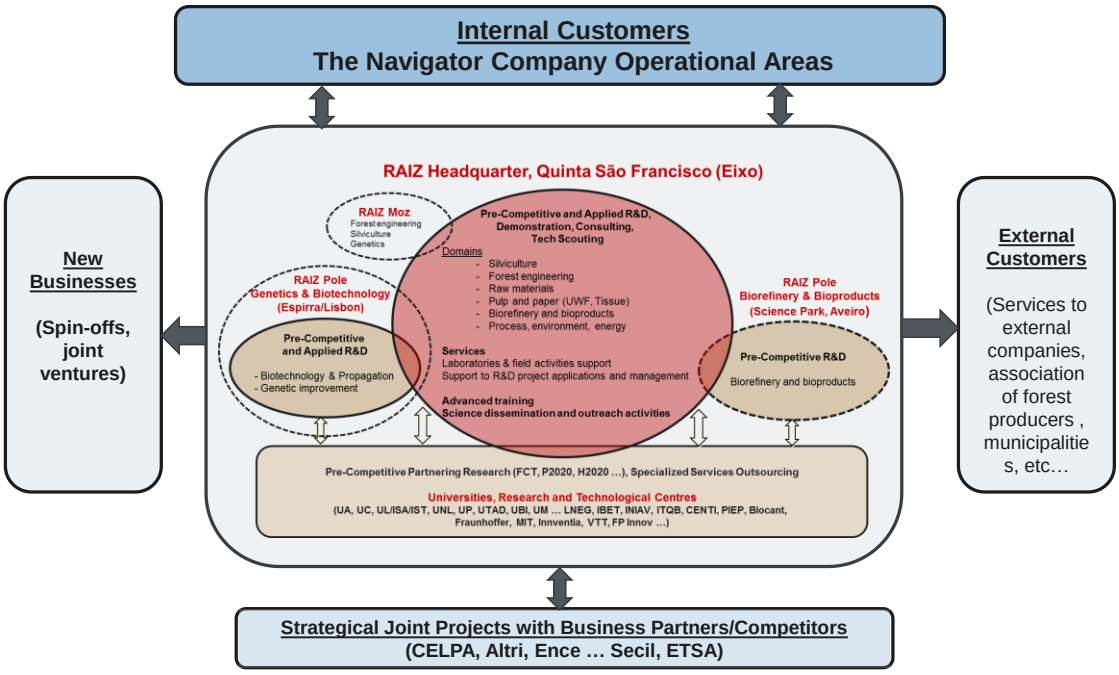
Figure 5. Business Finland Research Fund 2018

Source: Presentation of Jari Hyvärinen, available here

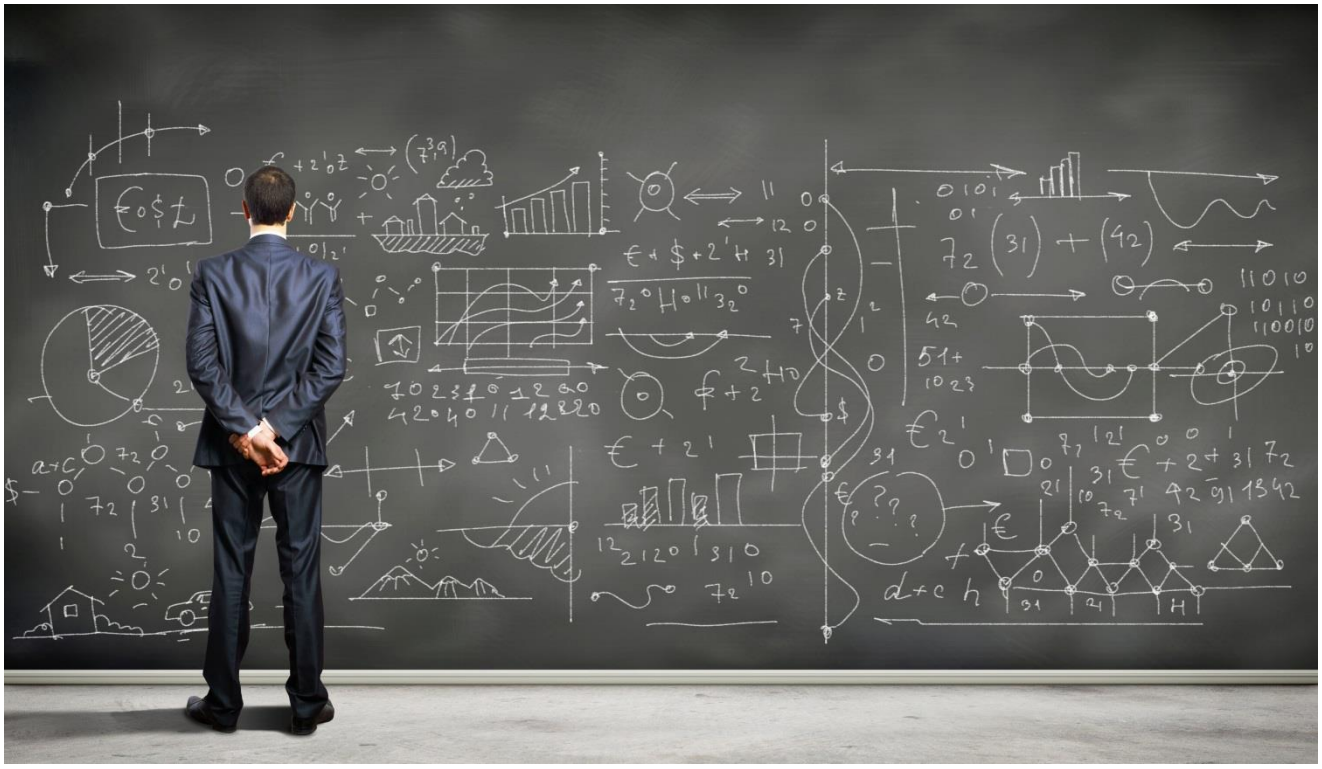
Sara Paulina Monteiro, S&T Manager at the Raiz Research Center of the Navigator Company, Portugal, reported on the nature of research collaborations her company was engaged in. The Navigator Company, which is the leading manufacturing firm of uncoated wood free printing and writing paper in Europe, established the RAIZ research centre in 1996. The centre, which has around 80 researchers, set up collaborations with several universities RAIZ is also engaged in strategic projects with other companies, which have resulted in new patents and spin-offs (Figure 6).

The InPaCTuS project, for instance, conducts research on innovative technologies around the use of eucalyptus in manufacturing of wood products. The project is funded with EUR 15 million and brings together several universities and private companies. It has resulted in 10 patents, 150 research articles, 4 spin-offs, and training of several PhDs.

Figure 6. RAIZ: multipolar centre of excellence improving links with innovation actors

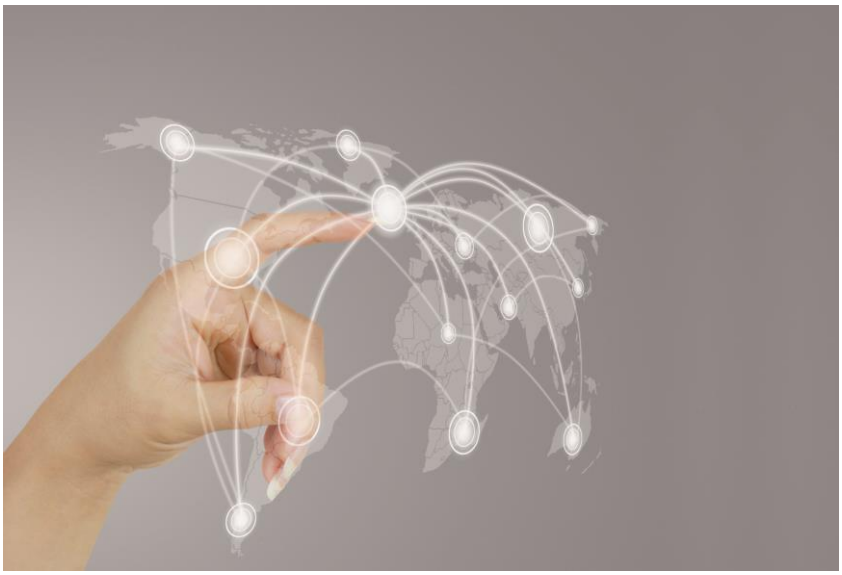


Source: Presentation of Sara Paulina Monteiro, available here.



3. International and intersectoral mobility of human resources

This session focused on how policy can support the evolution of young researchers so that they can best contribute to their countries' economic development. In a context where the supply of PhD holders continues to increase but demand for those skills is low, 'brain drain' can become a challenge in many countries. In turn, setting up collaborations with researchers and international collaborations can have strong positive effects on scientific performance and for more effective knowledge transfer.

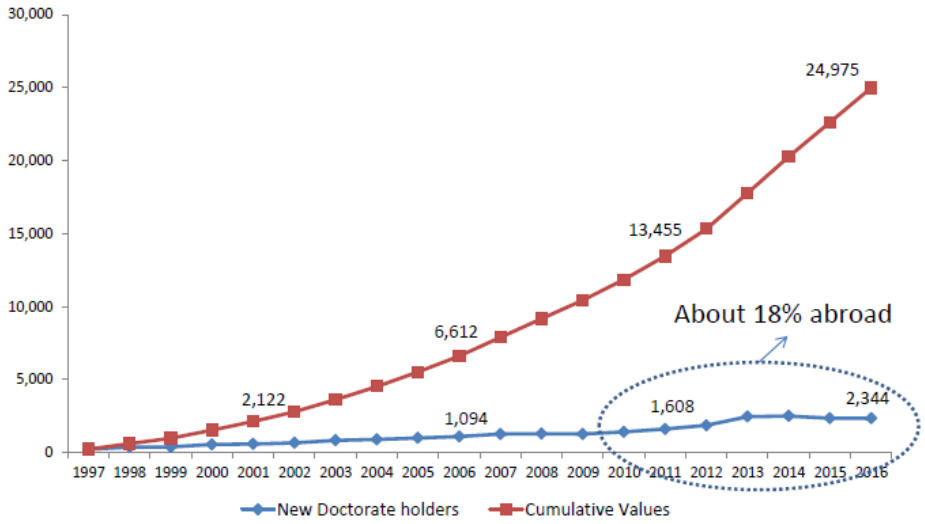


3.1. Supply and international/sectoral mobility of researchers: some trends

Luísa Loura, Director General for Statistics on Education and Science (DGEEC) in Portugal, presented recent statistical data from two national surveys (on R&D and on careers of doctorate holders (CDH), respectively). Figures show that in Portugal the number of new doctoral holders per year has more than doubled over the past decade, from 1,094 in 2006 to 2,344 in 2016 (Figure 7); and that around 18% of these new doctoral holders (from the period 2010-2016) are currently abroad.

This is partly the consequence of the mismatch between the supply and demand for those skills. In 2015 doctoral holders represented only 6.2% of the Portuguese labour force, one of the lowest shares in EU countries. In 2011-2012, 7.5% of doctoral holders were employed in business enterprises, up from 2.9% before 2005.

Figure 7. Doctoral holders in Portugal, 1997-2016



Source: Presentation of Luísa Loura, available here.

The share of researchers in the workforce has not only increased in Portugal. The evidence provided by Ana Correia, from DG Research and Innovation of the European Commission, shows an increase across Europe. However, significant differences exist across countries with regards to the following aspects:

- The absorption of researchers by the business sector is much higher in Nordic countries than in Southern and Eastern European countries.
- The intensity of collaboration between innovative enterprises and universities/ research institutes also differs across countries. Across all countries intensities of collaboration are lower among SMEs than large companies.

3.2. Researchers' mobility trends and "brain drain": what role for policy?

Sarah Parks, Senior Analyst of RAND Europe, presented the results of a recent study on international mobility of researchers in the UK (based on an online survey conducted on March 2017 to researchers in the UK, with 1,285 responses) (Guthrie et al., 2017). The survey finds that:

- Researchers move for professional motivations more than for personal reasons.
- Drivers and barriers for mobility vary depending on career stage and also, but to lesser extent, on personal circumstances.
- Around 80% of researchers interviewed considered that there is an expectation of international mobility in the research community.

With regards to the brain drain and gain debate, she provided evidence to show that the UK is a destination country: while it accounts for 5% of the OECD population, it hosts 15% of the students enrolled in masters and PhD degrees. In turn, the percentage of UK academic staff who are not UK nationals is of nearly 30% (2015-16) (up from 19% in 2005-06).

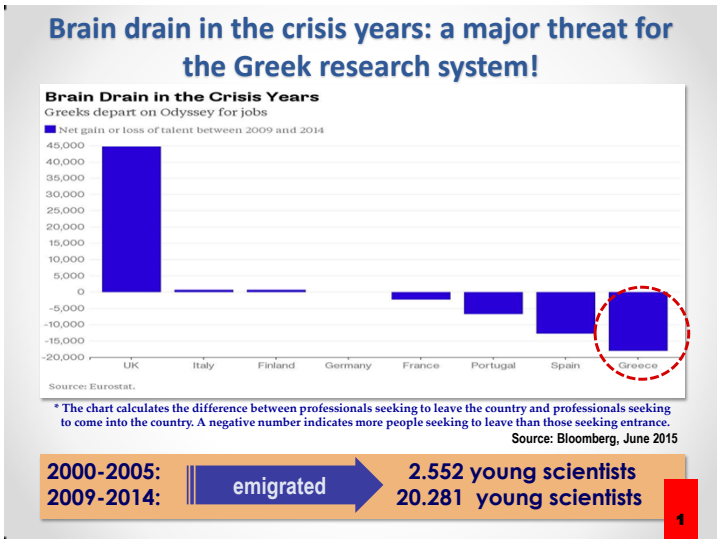
By contrast, Greece has very much suffered from "brain drain" following the global financial crisis that strongly affected the Greek economy. Agni Spilioti (Director of the Policy Planning Directorate at the Ministry of Education, Research and Religious Affairs, Greece) showed that, between 2009 and 2014, around 20,300 young scientists left the country – the highest net loss of talent among EU countries (Figure 8). She also indicated that the situation had improved since then, with lower numbers of departures of researchers.

Sarah Parks highlighted that mobility can benefit both host and home countries, and pointed to three key policy measures for encouraging researchers to return to the home country:

- Offering more job security for early career researchers;
- Define clear and accessible pathways to pursue and advance careers within and outside academia; and
- Support researchers overseas to maintain their relationships with those in their home country (e.g. small scale funding for travel costs, joint funding calls).

> Efforts to engage with the diaspora are being undertaken in Greece: the Knowledge Bridges programme was recently created to establish and maintain networks with the diaspora.
>
> *- Agni Spilioti*

Figure 8. Brain drain in Greece, 2000-2014



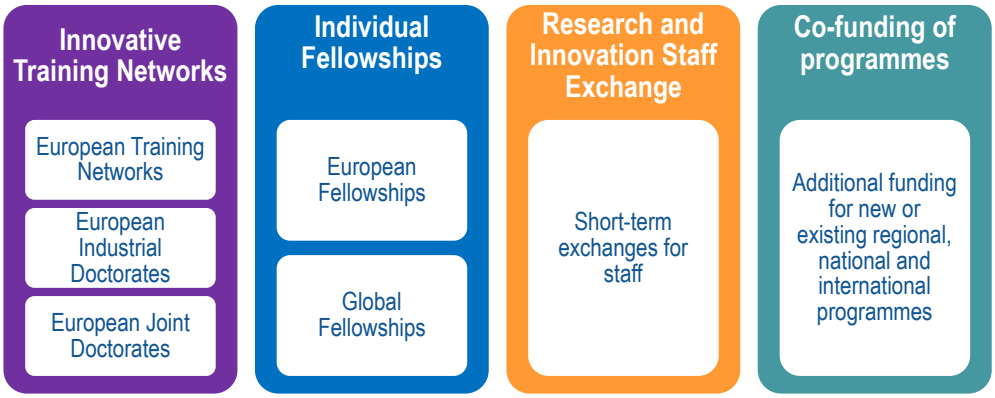
Source: Presentation of Agni Spilioti, available here.

3.3. Why and how should policy foster international mobility of researchers?

Ana Correia, from DG Research and Innovation of the European Commission, emphasized that international collaboration in research is important for innovation and has positive impacts in scientific performance. In light of these, the European Commission has programmes to encourage researcher mobility:

- The Marie Sklodowska-Curie programme provides funding for international and cross-sector mobility on the basis of excellent research for all stages of a researcher's career. The programme includes Innovative Training Networks, Individual Fellowships, Research and Innovation Staff Exchange and Co-Funding of Programs (The "EURAXESS-Researchers in motion" programme focuses on delivering information and support services to professional researchers, in order to promote researcher mobility and career development, thereby enhancing scientific collaboration across countries.
- Figure 9). The programme has a budget of EUR 6.16 billion for the 2014-2020 period, and over 65,000 researchers have been funded so far in this period.
- The "EURAXESS-Researchers in motion" programme focuses on delivering information and support services to professional researchers, in order to promote researcher mobility and career development, thereby enhancing scientific collaboration across countries.

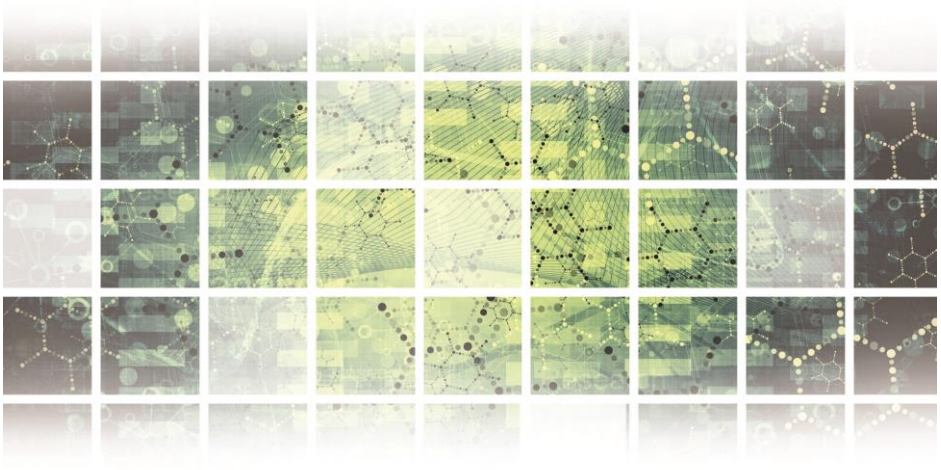
Figure 9. Marie Sklodowska-Curie actions



Source: Presentation of Ana Correia, available here

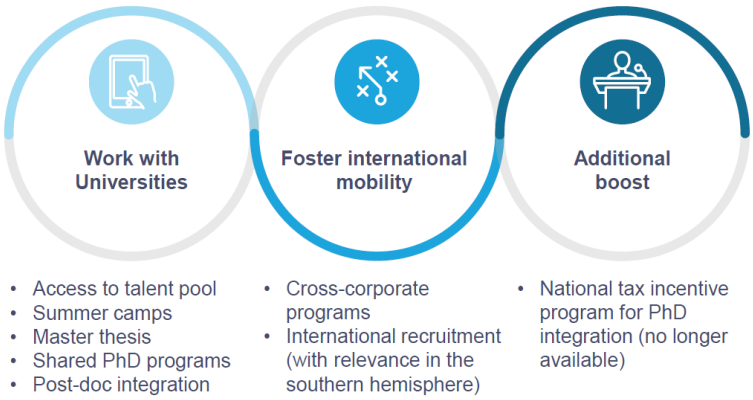
Dirk Meissner, Professor at the National Research University – Higher School of Economics (Russian Federation), explained recent developments to promote science-industry knowledge transfer and researcher mobility in the Russian Federation. The National S&T Strategy was approved in 2016. One of its main components is to promote international scientific collaboration and researchers' mobility.

Policy programmes to foster knowledge transfer are the university-company cooperation grants, mega-grants, Presidential fellowships for PhD students, and the development of technology platforms, innovative clusters and science cities. In addition, new policy programs to support international collaboration have been launched by the Russian Foundation for Basic Research, the Foundation for Assistance to Small Innovative Enterprises and the Russian Science Foundation.



Rodrigo Maia, Chief Technology Officer of Altran Portugal, provided a business perspective on the importance of international and intersectoral mobility of researchers. Altran is a multinational company specialized in engineering and R&D services, with over 1,700 employees in Portugal. He explained that Altran works intensively with Portuguese universities and polytechnics in order to access the talent pool, and also to develop specialized programmes to train students in their fields of interest. The company organizes different activities for this purpose, including summer camps, shared PhD programs, and post-doc integration. Altran also participates in programmes to foster international mobility, such as cross-corporate programmes whereby researchers and doctoral students from Portugal spend some time in Altran France (Figure 10). In 2013, the company opened a new Global Development Centre specialized in software development in Fundão, a small interior city in Portugal, in close collaboration with local universities and polytechnics to develop the necessary skills in the local labour market.

Figure 10. How to attract, retain and support the evolution of young researchers?



Source: Presentation of Rodrigo Maia, available here

4. Knowledge transfer to 'non-high-tech' industry and services and companies with low absorptive capacities

During the session, participants provided country insights on policies to stimulate knowledge transfer to services and non-high-tech industries. These include support for SMEs with lower absorptive capacity, and public-private partnerships.

4.1. Policies supporting SMEs

Participants agreed that a policy priority is to increase SMEs' absorptive capacities. Areti Gkypali from the Warwick Business School provided statistical evidence for the UK to show that, while SMEs have much to gain, they have fewer resources to collaborate with public research institutions. She argued that it is important to support SMEs to collaborate more with public research institutions in support.

Experimentation has led to different policy instruments tailored to SMEs, including investment in human capital and skills, on-the-job training, dissemination of best practices via industry-based associations, and stimulation of demand using innovation vouchers. New digital tools complement established policies, e.g. support apps that target those companies that are not on the radar of conventional R&D programmes.

4.2. Public-private partnerships

Region- and industry-based associations and consortia are important to help industry, and SMEs in particular connect with public research institutions. The experiences of Portugal's footwear and automotive industries show how industry associations accelerated the awareness of new ready-to-use technologies among SMEs nationwide, as indicated by Vítor Corado Simões from the Lisbon School of Economics and Business.

Public-private partnerships often provide access to critical research and testing infrastructure to SMEs. Joana Mendonça, from the Instituto Superior Técnico of the University of Lisbon, explained that public-private partnerships were essential for the broader adoption of Metal Additive Manufacturing (MAM) technologies among SMEs in Portugal's moulding industry. Public-private consortia that include larger companies, SMEs, universities and public laboratories allowed SMEs and traditional firms to gain access to university equipment for testing MAM technologies. Crucially, they increased trust among hesitant follower firms in the ready-to-use technologies.

5. The role of knowledge intermediaries for knowledge transfer

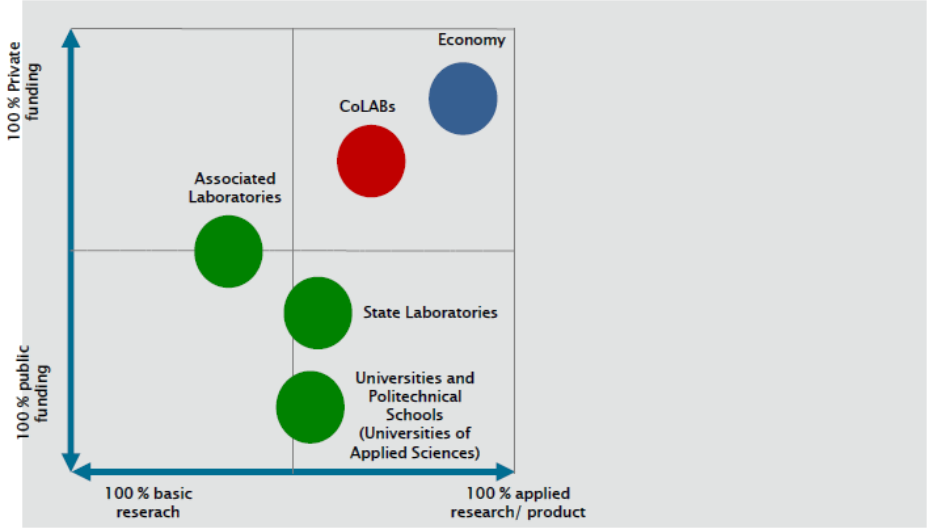
Intermediaries are important for effective co-creation of public institutions and private industry. New knowledge intermediaries have been established to develop transformative technologies and support their adoption in the economy. Organisations such as the Austrian CDG, CoLABS in Portugal, and the UK's Catapults provide new spaces for collaboration between large companies, SMEs, universities, and the civil society (see Box 5).

Box 5. National approaches to knowledge intermediaries

CoLABS in Portugal

In Portugal, collaborative laboratories (CoLABs) are newly established intermediary institutions where public researchers engage in applied research in close partnership with industry. Similar to Germany's Fraunhofer institutes, CoLABs aim to bridge the gap between research at universities and public laboratories and the market (Figure 11).

Figure 11. CoLABs as intermediaries between science and industry in Portugal



Note: CoLABs are shown as the circle in red in the figure below.
Source: Presentation of José Luis Encarnação, available here.

José Luis Encarnação from the International Assessment Commission of the Collaborative Laboratories in Portugal explained that CoLABSs will have a high share of more than 50% of industry funding while their public grant are to be used for the creation of PhD positions and highly skilled jobs. A question that arises in this context is whether the high industry share will lead the CoLABS to compete with industry in some regards. One response to this is to provide sufficient block funding so that their focus is

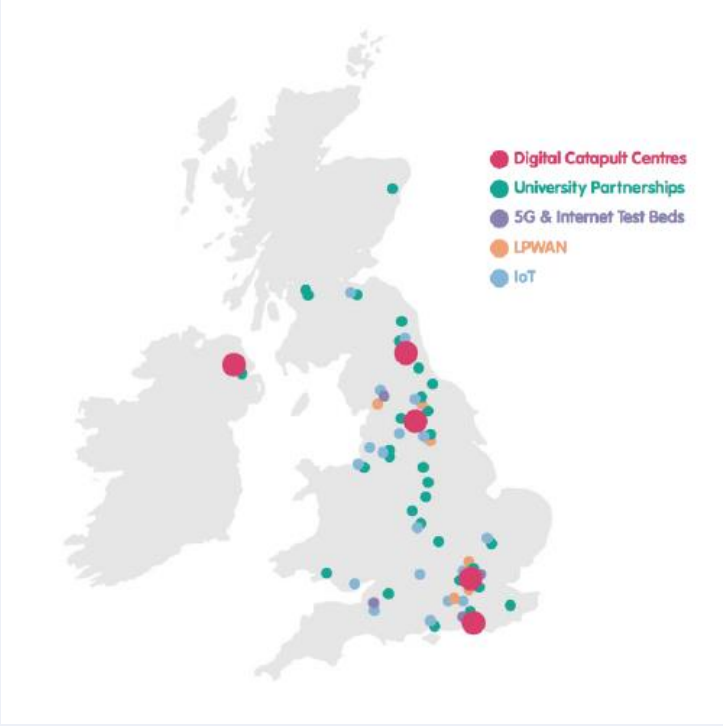
on industry needs.

UK Catapult centres

Catapult centres are intermediary organisations set up by agency Innovate UK to promote research and development through business-led collaboration between scientists and engineers. Brian MacAulay, lead economist of the Digital Catapult in the United Kingdom, discussed the Catapult's role in supporting the diffusion of enabling technologies such as artificial intelligence, biotechnology and robotics. This is done by stimulating demand for technology by de-risking innovation, testing new ideas and technology in real-world scenarios, and sharing ideas across sectors. The centres also provide support for SMEs to get their new ideas and technologies quicker to the market.

10 Catapults have been established so far, each specializing in different technologies. Each Catapult has several centres spread across the UK, but all work with a different model, and some are more capital intensive than others. Figure 12 shows the science-industry network of the Digital Catapult that also includes local digital innovation initiatives for 5G mobile networks, Internet of Things (IoT), and Low Power Wide Area Network (LPWAN) used for long range communications among things ("connected objects").

Figure 12. Digital Catapult's science-industry network



Source: Presentation of Brian MacAulay, available here.

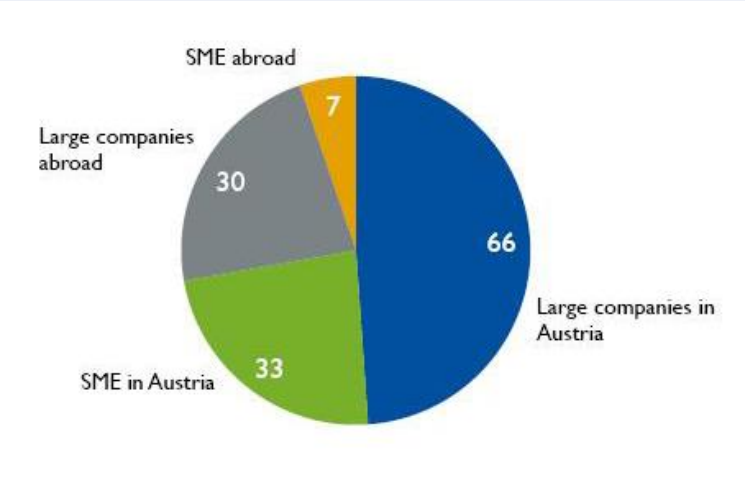
Christian Doppler Forschungsgesellschaft (CDG) in Austria

While CoLABs and Catapult centres are newly established entities outside of existing universities and research laboratories, the CDG laboratories represent a more flexible approach to promote knowledge transfer between universities and industry in Austria. Haio Harms, Executive Board Member of CDG, explained that CDG laboratories are flexible because they do not involve the establishment of new legal entities but are hosted at universities and will close after a maximum period of 7 years.

Industry and university departments jointly select research topics and apply for funding. The selection of applicants is based on peer-review while continuation of CGD laboratories is based on mid-term evaluations. Individual contracts between the hosting university and the company are sufficient to make the programme work. While researchers have high degree of scientific freedom including the right to publish results from joint research, industrial partners obtain the right over patents.

With a budget of 30 Mio. EUR in 2017 for basic research, the 80 CDG laboratories at universities and 10 Josef Ressel-Centres at universities of applied science connect 145 industry partners with more than 1000 scientists, including SMEs (Figure 13).

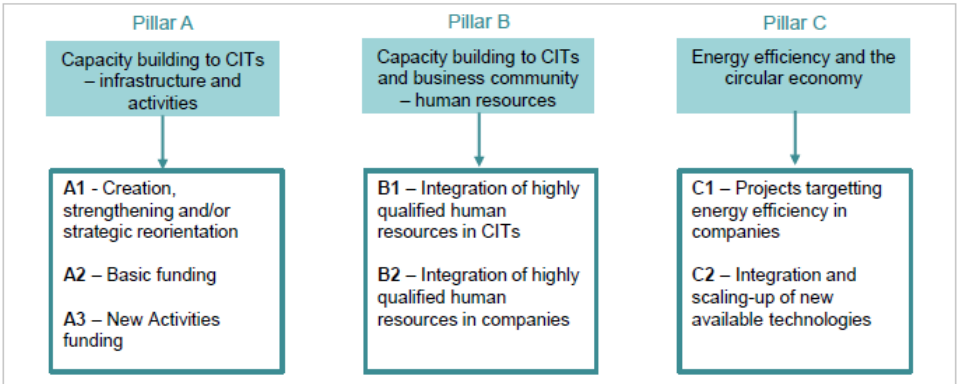
Figure 13. CDG industry partners by company size and origin, 2016



Source: Presentation of Haio Harms, available here.

Policy is shifting resources towards supporting intermediary organisations. José Carlos Caldeira, President of the National Innovation Agency (ANI) in Portugal, highlighted that the ANI's range of policy instruments has now a stronger focus on intermediary organisations between science and industry. The Technological Interface Centres (CIT) programme is a key component in Portugal's policy mix and provides funding to improve intermediary organisations in Portugal (Figure 14).

Figure 14. Technological Interface Centres (CIT) program



Source: Presentation of José Carlos Caldeira, available here.

The Portuguese Center for Engineering and Product Development (CEiiA) provides networks to facilitate firms' access to foreign markets, offers fast and non-bureaucratic access to public research laboratories and equipment for firms and entrepreneurs, and addresses cultural and communication barriers between industry and universities. These barriers are especially acute in low-tech sectors, so that the need for intermediaries becomes higher in this context. Tiago Rebelo, Head of Aerospace and Ocean Engineering at CEiiA, illustrated how intermediaries organized local stakeholders in the aircraft industry in Portugal so that they could cooperate and compete at the same time and better connect global value chains.

6. Incubators supporting spin-offs

Incubators are becoming increasingly important policy tools to stimulate spin-off creation, as was explained by Sophie Viscido from the European Association of Research and Technology Organisation (EARTO). Incubators are technology transfer intermediaries that provide a wide range of support services and funding to spin-offs, and often provide due diligence services for investors, helping them assess the technology value of spin-offs.

João Paulo Dias, from the Pedro Nunes Institute in Portugal, offered further detail on their incubator. The incubator has hosted over 260 firms over the last 20 years across a broad range of industries. The spin-offs it supported have a survival rate of more than 75%. This very high survival rate is a result of strict preliminary screening of projects, and to the comprehensive support services provided and easy access to advanced knowledge at the partnering University of Coimbra.

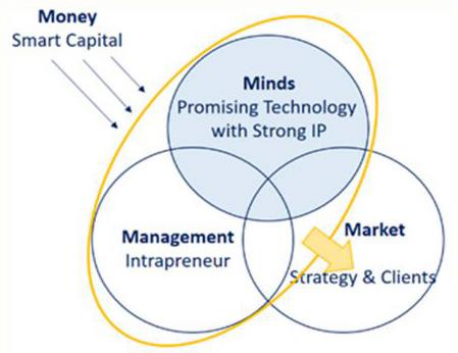
Policy experimentation has led to the emergence of two approaches for successful start-up creation (Box 6). After successful experimentation with targeting the start-up phase of firms, policy-makers should focus more on financial schemes to support technology maturation, so that spin-offs become investment-ready faster.

Box 6. Two approaches to support high-tech spin-off creation

Student entrepreneurship (inside-out approach)

1. Spin-off creation in incubators happens via two routes. The first is the inside-out approach, which starts with the development of a new technology and then tries to move into the market. Smart team of students need to develop the market and the technology hand in hand and to identify the industrial clients interested in the technology.

Figure 15. Inside-out approach to spin-offs

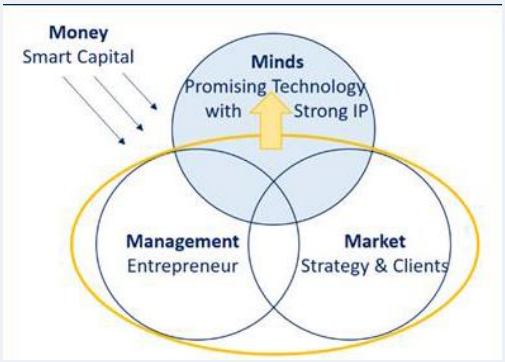


Source: Presentation of Sophie Viscido, available here.

Management by outside entrepreneurs (outside-in approach)

A second route of spin-off creation is the outside-in approach, where normally an outside entrepreneur with a good vision of the market comes to the incubator in search of a technological solution to an existing problem. The entrepreneurs then develop a promising technology portfolio for the new business in collaboration with the incubator. After project ends, the incubator can take the opportunity to invest in the start-up. Sophie Viscido argued that this second approach is very relevant in lagging regions.

Figure 16. Outside-in approach to spin-offs



Source: Presentation of Sophie Viscido, available here.

7. What is the right policy mix for knowledge transfer?

This concluding session focused on the policy mix for knowledge transfer, including the right balance between established and new instruments, challenges to the implementation of the policy mix and building synergies between regional, national and international policies to promote knowledge transfer.

There was agreement that it is of critical importance to reflect on the compatibility between instruments. Agni Spilioti pointed out that after the development of many different policy instruments, a key challenge for now is to better integrate those different policies into a coherent policy mix. This requires a diagnosis of missing elements and finding the right balance between targeted and generic instruments.

Policy has experimented with combinations of established and new policy instruments. Margarida Fontes, from the National Laboratory on Energy and Geology in Portugal, explained that the introduction of new policy instruments to support knowledge transfer did not occur in a "blank sheet" and there were attempts to build synergies between the different instruments. In the case of ocean energy technologies in Portugal, the policy mix combined traditional R&D and innovation incentives already in place with new demand-side policies. New policy instruments were also introduced with the aim of supporting pilot and demonstration projects.

There is an additional layer of complexity because of European and international policies. Francisco Vilhena da Cunha (on the picture to the right) from Tekever, a Portuguese IT, explained how national and European funding schemes are highly complementary. His company has a large portfolio of research projects and most of these projects are supported by national and European funding, which contributes to increasing linkages with universities in the context of research consortia.

In the same line, José Carlos Caldeira (on the picture to the left) from the National Innovation Agency (ANI) in Portugal argued that synergies between European, national and regional public funding for research collaborations need to be better exploited.

The implementation stage of policies is critical for synergies to materialise. In Portugal, the main priority should now be to improve the implementation of policy instruments, argued Margarida Fontes. The coordination between different government areas is very complex and the different implementation paces have led to lost opportunities to exploit synergies and interdependencies between different policy instruments.

> The main problem in fostering knowledge transfer is not lack of policy instruments, but rather the efficient implementation of these instruments to make them work together in a synergistic way.
>
> *- Vítor Corado Simões*

National strategies are common instruments to match the different interests and capacities of stakeholders involved in knowledge transfer, including society. The choice of the policy mix is shaped by multiplicity of actors, which may have different interests and capacity to voice them. Margarida Fontes explained that in Portugal a clear policy strategy was formulated in collaboration with stakeholders from academia, industry, and policy. Stakeholder participation ensured that there was a match between interests of industry and capacities of academia as well as with societal challenges as identified by policy. The strategy provided a vision of future benefits, defined a long-term horizon, and offered legitimacy. However, stability in the policy outlook is crucial to reap the expected response.

The workshop concluded with a final roundtable that also pointed to questions requiring further attention (see Box 7).

Box 7. Topics requiring further attention

- **There is no "one size fits all" policy** in a highly specialised higher education landscape and the diversity of actors creates new challenges for policies. A better understanding of the implications of greater complexity on policy would help inform policy in this regard.

- **There is a diversity of policy instruments** that jointly address diverse models of knowledge transfer between science and industry, including collaborative research, spin-offs, but also outreach to the local community and SMEs. The policy mix is a result of diverse policies adopted at different times and understanding the interactions among policy instruments is still challenging.

Prof. Vítor Corado Simões
Lisbon School of Economics and Business

- **The challenge is to keep the policy mix simple and accessible** for businesses and researchers. Complexities are often a major barrier to collaboration between public research institutions and industry, particularly for smaller firms. Creating specific support to help overcome those obstacles is critical.

- **Policies need to consider rewarding researchers and industry for collaborating.** There should be incentives for both sides to collaborate and the conditions for collaboration also need to be set out clearly. Defining the ownership and use rights for joint research outputs that recognise the contributions of public funding to joint collaborations is important where co-creation gains in importance. The right balance needs to be found.

- Among the diverse channels of knowledge transfer, the **integration of highly skilled personnel and PhDs into the private sector** and mobility across both sectors is a core priority. Yet often such mobility is not straightforward and requires a mix of legal conditions but also adequate incentives.

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List of speakers

Eduardo Beira, Coordinator, Programme for the Modernisation and Valorisation of the Polytechnic Higher Education, Portugal

José Bonfirm, Foundation for Science and Technology (FCT), Portugal

Martin Borowiecki, Junior Economist, Directorate for Science, Technology, and Innovation, OECD

Isabel Caetano, Board member, National Innovation Agency (ANI), Portugal

José Carlos Caldeira, President, National Innovation Agency (ANI), Portugal

Etienne Choupay, Project Coordinator, Innovation Division, Ministry of the Economy, Development and Tourism, Chile

Vítor Corado Simões, Professor, Lisbon School of Economics and Business, Portugal

Ana Correia, Policy Analyst, Directorate-General for Research and Innovation, European Commission

Catarina Dantas Machado, European Semester Office (ESO), European Commission

João Paulo Dias, Pedro Nunes Institute, Portugal

José Luis Encarnação, Coordinator, International Follow-up and Assessment Commission of the Collaborative Laboratories, Portugal

Ana Feijão, Foundation for Science and Technology (FCT), Portugal

Daniel Ferreira, Foundation for Science and Technology (FCT), Portugal

Isabela Ferreira, Professor, Mountain Research Center (CIMO), Bragança Polytechnic Institute, Portugal

Joao Nuno Ferreira, Foundation for Science and Technology (FCT), Portugal

Inês Fonseca, Foundation for Science and Technology (FCT), Portugal

Margarida Fontes, Researcher, National Laboratory on Energy and Geology (LNEG), Portugal

Elvira Fortunato, Vice Rector, New University of Lisbon, Portugal

Areti Gkypali, Research Fellow, Warwick Business School, United Kingdom

Dominique Guellec, Head of Division, Directorate for Science, Technology, and Innovation, OECD

José Guimón, Associate Professor, Autonomous University of Madrid, Spain

Haio Harms, Executive Board Member, Christian Doppler Forschungsgesellschaft (CDG), Austria

Manuel Heitor, Minister of Science, Technology and Higher Education, Government of Portugal

Jari Hyvärinen, Senior Advisor, Finish Funding Agency for Innovation (Tekes), Finland

Vanja Karadzic, Foundation for Science and Technology (FCT), Portugal

Haakon Kobbenes, Senior Advisor, Ministry of Education and Research, Norway

Philippe Larrue, Policy Analyst, Directorate for Science, Technology, and Innovation, OECD

Luísa Loura, Directorate General, Directorate-General for Statistics on Education and Science (DGEEC), Portugal

Brian MacAulay, Lead Economist, Business Performance, Modelling and Evaluation, Digital Catapult, United Kingdom

Rodrigo Maia, Chief Technology Officer, Altran, Portugal

Carlos Martins, Foundation for Science and Technology (FCT), Portugal

Dirk Meissner, Deputy Head and Professor, Research Laboratory for Science and Technology Studies, National Research University – Higher School of Economics, Russian Federation

Ricardo Mendes, Founder and CEO, Tekever, Portugal

Joana Mendonça, Assistant Professor, Instituto Superior Técnico, University of Lisbon, Portugal

José Manuel Mendonça, President, Institute for Systems and Computer Engineering, Technology and Science (INESC-TEC) Associate Laboratory, Portugal

Paula Mira, Foundation for Science and Technology (FCT), Portugal

Sara Paulina Monteiro, S&T Manager, InPaCTus, Raiz Research Research Centre, The Navigator Company, Portugal

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Ana Neves, Foundation for Science and Technology (FCT), Portugal

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Agni Spilioti, Director, Policy Planning Directorate, General Secretariat for Research and Technology, Ministry of Education, research and Religious Affairs, Greece

Pedro Teixeira, Director, Centre for Research on Higher Education Policies, Portugal

Francisco Vilhena da Cunha, Tekever, Portugal

Guy Villax, CEO, Hovione, Portugal

Sophie Viscido, Policy Officer, European Association of Research and Technology Organisation (EARTO), Belgium

Isabel Vitorino, Foundation for Science and Technology (FCT), Portugal

Agenda of the workshop

Tuesday, 7 November

9h30 - 10h30: Opening and introductory presentations

- Opening of the workshop
- Introduction to the workshops and objectives
- Q&A

Speakers:

- Manuel Heitor, Minister of Science, Technology and Higher Education, Government of Portugal
- Dominique Guellec, Head of Division, Directorate for Science, Technology and Innovation, OECD
- Helena Pereira, Vice-President, Foundation for Science and Technology (FCT), Portugal
- Caroline Paunov, Senior Economist, Directorate for Science, Technology and Innovation, OECD

10h30 - 12h30: Panel 1 - Challenges to the stimulation of technology transfer in Portugal

- Presentation of the ongoing Innovation Policy Review of Portugal by Dominique Guellec (Head of Division, OECD) and Philippe Larrue (Policy Analyst, OECD)
- Perspectives on knowledge transfer and the Innovation Policy Review from Portugal
- Q&A

Chair: Helena Pereira, Vice-President, Foundation for Science and Technology, Portugal

Speakers:

- José Luis Encarnação, Coordinator, International Follow-up and Assessment Commission of the Collaborative Laboratories, Portugal
- José Manuel Mendonça, INESC-TEC Associate Laboratory, Portugal
- Guy Villax, CEO, Hovione, Portugal
- Elvira Fortunato, Vice Rector, New University of Lisbon, Portugal
- Isabel Caetano, Board Member, National Innovation Agency, Portugal
- Q&A

13h30 - 15h00: Panel 2 - Science, innovation and knowledge transfer in a diversified higher education landscape

Questions addressed by the panel:

- How to best organise science and higher education and their relations with industry, in a configuration where research universities (driven toward excellence but under mounting pressure to also produce useful research-based innovation) coexist with universities of applied research (i.e. 'polytechnics', expected to engage in practice-based research and professional development, with close relationships with local communities and SMEs, in particular through innovation)? What division of labour between institutions works best? What are

opportunities for synergies?
- What best practice examples exist in Portugal and abroad?
- Q&A

Chair: Dominique Guellec, Head of Division, Directorate for Science, Technology and Innovation, OECD

Speakers:

- Haakon Kobbenes, Senior Advisor, Ministry of Education and Research, Norway
- Etienne Choupay, Project Coordinator, Innovation Division, Ministry of the Economy, Development and Tourism, Chile
- Eduardo Beira, Programme for the Modernisation and Valorisation of the Polytechnic Higher Education, Portugal
- Sara Paulina Monteiro, S&T Manager, InPaCTus, Raiz Research Centre, The Navigator Company, Portugal
- Haio Harms, Executive Board member, Christian Doppler Forschungsgesellschaft (CDG), Austria
- Jari Hyvärinen, Senior Adviser, TEKES – Finish Funding Agency for Innovation, Finland
- Q&A

Commentator: Isabel Ferreira, Professor, CIMO, Bragança Polytechnic Institute, Portugal

15h30 - 17h00: Panel 3 - International and intersectoral mobility of human resources

Questions addressed by the panel:

- How to attract, retain and support the evolution of the best human resources and young researchers so that they best contribute to the country development? How can this be done in a context of limited public budgets and limited private sector recruitment of highly qualified human resources?
- How can trained human resources be used more effectively to support competitive science-based industries? Is creating more opportunities for spin-offs created by PhDs and researchers an option? What about the role of intermediary institutions that serve as conduits of knowledge sharing between industry and science?
- Q&A

Chair: Philippe Larrue, Policy Analyst, Directorate for Science, Technology and Innovation, OECD

Speakers:

- Luísa Loura, Director General, Directorate-General for Statistics on Education and Science (DGEEC), Portugal
- Sarah Parks, Senior Analyst, RAND Europe, United Kingdom
- Pedro Teixeira, Director, Centre for Research on Higher Education Policies, Portugal
- Ana Correia, DG Research and Innovation, European Commission
- Rodrigo Maia, Chief Technology Officer, Altran, Portugal
- Dirk Meissner, Deputy Head and Professor, Research Laboratory for Science and Technology Studies, National Research University - Higher School of Economics, Russian Federation
- Q&A

Commentator: Agni Spilioti, Director, Policy Planning Directorate, General Secretariat for Research & Technology, Ministry of Education, Research and Religious Affairs, Greece

Wednesday, 8 November

9h30 - 11h00: Panel 4 - Knowledge transfer to 'non high-tech' industry and services and companies with low absorptive capacities

Questions addressed by the panel:

- How to initiate a virtuous circle between the demand for innovation and the offer of innovative solutions in an environment where most industries and companies have a low absorptive capacity and, even more, no formalised demand for innovation?

- How can public support trigger such virtuous circle?
- More research spinoffs can help where industry is not prepared for research uptake. How can policy support their creation?
- Q&A

Chair: José Guimón, Associate Professor, Autonomous University of Madrid, Spain

Speakers:

- Agni Spilioti, Director, Policy Planning Directorate, General Secretariat for Research & Technology, Ministry of Education, Research and Religious Affairs, Greece
- Vítor Corado Simões, Professor, Lisbon School of Economics and Business, Portugal
- Sophie Viscido, Policy Officer, European Association of Research and Technology Organisations (EARTO), Brussels
- João Paulo Dias, Pedro Nunes Institute, Portugal
- Joana Mendonça, Assistant Professor, Instituto Superior Técnico, University of Lisbon, Portugal
- Q&A

Commentator: Tiago Rebelo, Head of Aerospace and Ocean Engineering, CEIIA, Portugal

11h15 - 12h30: Panel 5 - What is the right policy mix for Knowledge Transfer?

Questions addressed by the panel:

- What is the optimal policy mix for knowledge transfer? How can the different policy instruments available to policy makers to support knowledge transfer?
- What factors are critical to understand synergies and possible conflicting effects across these instruments? What social and economic conditions of countries and regions influence the possible impacts of these policies?
- What role can knowledge intermediaries play in supporting knowledge transfer?
- Q&A

Chair: Caroline Paunov, Senior Economist, Directorate for Science, Technology and Innovation, OECD

Speakers:

- Margarida Fontes, Researcher, National Laboratory for Energy and Geology (LNEG), Portugal
- Brian MacAulay, Lead Economist – Business Performance, Modelling and Evaluation, Digital Catapult, United Kingdom
- Francisco Vilhena da Cunha, Tekever, Portugal
- Areti Gkypali, Research Fellow, Warwick Business School, United Kingdom
- José Carlos Caldeira, President, National Innovation Agency (ANI), Portugal
- Q&A

12h30 – 12h45: Wrap up of the workshop

- Main takeaways from the discussion regarding knowledge transfer
- Tour de table