European Commission

TECHNOLOGY TRANSFER IN AZERBAIJAN 2019-2020

SCIENCE, TECHNOLOGY, INNOVATION

Joint Research Centre

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Introduction

The present report contributes to the European Commission's commitment of bringing the EU and its neighbours closer. The EU's European Neighbourhood Policy was launched in 2004 to help the EU support and foster stability, security and prosperity in its closest neighbourhood, and it governs the EU's relations with 16 of its closest Eastern and Southern Neighbours.

The EU is committed to supporting the economic development of its partner countries. Technology transfer represents a central area where distinct sections of society including academia, private research, government and public and private enterprises interface with one another to improve the overall economic and social conditions for those involved and the communities around them. By investing in the facilitation of technology transfer, governments can direct policy and funds to ensure the greatest outcome for society. With this process in mind, the ultimate objective of the present study is to inform policymaking in technology transfer and build stronger cooperation between the EU and its Eastern and Southern neighbours.

Methodology

The Competence Centre on Technology Transfer of the Joint Research Centre launched this study to conduct a brief diagnostic analysis and comparative overview of the state of Technology Transfer in twelve Eastern and Southern neighbouring countries, including Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Ukraine, Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia.

The study describes the main characteristics of the landscape, including relevant stakeholders, players and technology transfer models, identifies strengths and weaknesses of the ecosystem, and provides conclusions and recommendations for each country, with the aim of informing policymaking in this domain.

To achieve this objective, the Expert Group commenced with a desktop review to gather, examine and understand relevant policies, laws and literature concerning technology transfer in the respective study countries. This preliminary phase was employed in order to characterise the status of the technology transfer in the region, to identify the key stakeholders, crucial issues and possible areas of improvement.

Secondly, the identified issues served as guiding material in the design of questionnaires for relevant stakeholders. The list of stakeholders included: Government bodies (Ministries with role in intellectual property and innovation, i.e. Ministry of Science, Education, Economy, etc., Innovation Agencies), Universities, Academies of Sciences (management, technology transfer offices, researchers), Industry (incubators, science and technology parks, companies), and private investors.

On-site interviews with stakeholders took place in some of the study countries before March 2020, however, in order to respect health and safety concerns of the Coronavirus disease (COVID-19), all interviews that took place after March 2020 were online via video conferences. Both the information from questionnaires and interviews helped as source data for the diagnostic country reports – an analysis of the technology transfer ecosystem and country specific recommendations.

Lastly, the study will conclude with a benchmark report to detail some of the similarities and differences between the countries to give relevant comparisons.

EXECUTIVE SUMMARY

Government

The Republic of Azerbaijan is a resource rich country which has used its wealth since gaining independence to reduce poverty. Looking to the future it now seeks to become a knowledge-based economy. The government has recognised that to meet this objective it needs to diversify from oil and gas and to improve innovation capability. The national development strategy, Azerbaijan 2020: Vision for the Future, attaches great importance to innovation-driven growth. Innovation-led growth is a declared national priority, and a national innovation strategy has been developed. Numerous government agencies have been set up and tasked with improving the innovation ecosystem and a significant number of measures have already been taken to reach this objective while others are emerging, but more time is needed for these measures to become fully operational and for their impact to be comprehensively measured.

Progress in diversification away from oil and gas has, so far, been limited and economic growth in Azerbaijan is still heavily dependent on hydrocarbons. More effort is needed to support the emergence of alternative industries by helping small and medium enterprises (SMEs) to access new knowledge and research results to drive innovation and develop new products and services that can be competitive on a global scale.

The national policy framework for research, development and innovation remains highly fragmented with a number of ministries setting their own priorities and driving diverse and sometimes overlapping initiatives. Coordination is limited but there are signs that efforts are being made to improve this, for instance the launch of the national Coordination Council. Despite the construction of high-technology parks, technology commercialisation based on research remains very low. Some progress has been made in developing digital government platforms but digitalisation of industrial processes and more generally across the community requires acceleration if Azerbaijan is to fulfil its potential.

Some international observers continue to express some concern about corruption in both the public and private sectors. This needs to be addressed to prevent it being an obstacle to foreign direct investment (FDI) or to international collaboration which could be an important driver of innovation. Government funding of research in Azerbaijan is low as a percentage of Gross domestic product (GDP) and yet it represents most of the research spending in the country.

Universities and research organisations

Azerbaijan has a very high number of universities and research organisations but the output of this system both in terms of quantity and quality remains low. Too many institutions and a fragmented system cause dispersion of resources leading to chronic underfunding and low performance. There is insufficient participation in international collaborations.

Azerbaijan's National Strategy for the Development of Education (2015-2025) recognised the need to invest in science, technology, engineering and mathematics (STEM) education and led to a number of initiatives in this field. However, more needs to be done to drive the impact of such programmes. The education system shows little sign of alignment with the needs of the business community. Businesses in general and SMEs in particular appear to have trouble finding the talent they need. In education, as in research, government funding is limited. There are limited international mobility programmes and few examples of bilateral cooperation between specific Azerbaijani Higher Education Institutions (HEIs) and international institutions. The overwhelming majority of research (approximately 86%) is conducted by the government with only 9% conducted by HEIs and very little in the private sector (UNECE, 2020).

There seems to be little in the way of coordinated outreach on behalf of the research institutions to engage with industry, and even less effort to identify industry's needs as an input to the definition of research programmes and the development of future research infrastructure and capabilities. In terms of TT capabilities present in the HEIs and research institutions, the general impression was of limited awareness and understanding of the key principles of TT. Very few HEIs have start-up or spin-off company success stories and often the companies that are born remain small single product or niche market companies and struggle to scale-up or make a significant impact in terms of market share, turnover, or employment creation.

Industry

Most of the data available suggests that innovation levels are very low. Private sector involvement in research & development (R&D) remains very weak. Contributory factors include funding difficulties, and a lack of awareness within the business community of the research infrastructures and competences available within the research institutes. The corporate landscape in Azerbaijan is dominated by the oil and gas industry and while there has been some diversification more needs to be done if the economy of Azerbaijan is to become more balanced.

One of the problems the industry is facing is the attraction of skilled workers. Many of the workers available on the job market were trained to work in specialised industries and their skills are not readily transferable into other sectors, thus creating a barrier to innovation in the economy generally. As mentioned earlier, HEIs have not yet been able to fully adapt their offering to meet the needs of industry, both in terms of supplying graduates with the right skill sets and in terms of opportunities for partnerships with industry.

Start-up development in Azerbaijan is growing but from a very small base and remains limited. There are promising initiatives in this area, but more time is needed to assess their performance.

Support organisations

Up until a few years ago, the support network for innovation in Azerbaijan was limited but in recent years there have been a number of new initiatives and some promising support organisations have been created. It is too early to fully assess whether these initiatives will yield the hoped-for results. The creation of dedicated agencies is an important step forward, but it is equally important to ensure that they are appropriately staffed and funded and that their efforts are coordinated to ensure an optimum impact on the innovation ecosystem. The Azerbaijani government is to be commended for moving forward on their agenda to create a knowledge-based economy, but vigilance and transparency will be needed if these early steps are to deliver on their promise and make the hoped-for contribution to innovation in Azerbaijan and the region.

Engagement with the diaspora has begun to improve with several government schemes developing to strengthen networks in recent years. In 2018 the first summer camp for Azerbaijani living abroad was run and a Diaspora Youth organisation was established the same year. To improve cooperation among diaspora organisations coordination councils have been established in numerous countries including a number of European states.

Technology transfer

The innovation ecosystem is still evolving and TT activity is limited. There is a shortage of TT professionals with the full range of skills necessary to fully develop and sustain the national innovation ecosystem. University-industry collaboration exists but is limited and primarily driven by government funded programmes and the oil and gas sector. Azerbaijan is not as fully engaged with the international scientific community as it could be. Knowledge diffusion is improving but more work is needed in developing the linkages between research and industry. Early-stage investment remains an issue and will most likely require significant public intervention to initiate the process before private sector capital will get involved. Skills building programmes will be key to obtaining the competences necessary to accelerate Azerbaijan's passage to becoming a knowledge economy.

The roles and functions of the various new agencies and the other actors in the innovation ecosystem are not yet fully developed and there is always potential for overlapping responsibilities, duplication, or gaps in the process, but if attention is paid to coordination of these various agencies and programmes and best practices are observed and adapted to the Azerbaijan context, then there is significant potential for improvement and growth.

GENERAL FINDINGS

Government

The Republic of Azerbaijan is a resource rich country with a growing and relatively young population of around 10 million. It has been estimated[1] that at the end of the 20th century, about 13 million Azerbaijanis lived abroad, most of them in Iran. Having gained its independence from the Soviet Union in 1991 Azerbaijan succeeded in reducing poverty and used revenues from oil and gas to develop its infrastructure.

In terms of Institutional quality, according to an analysis in the United Nations Economic Commission for Europe Sub-regional Innovation Policy Outlook (UNECE IPO) (UNECE, 2020) based on an average of the World Governance indicators (Kaufmann and Kray, 2020) of control of corruption, government effectiveness, rule of law and voice and accountability Azerbaijan scored -0.8, lower than the sub-regional average of -0.3. According to transparency international[2] Azerbaijan was ranked 126/180 countries in 2019 with a score of 30/100. Clearly more can be done to improve the perception of the levels of corruption both within the country and abroad. This is an essential prerequisite to attracting FDI as a stimulus to a knowledge-based economy. The 2019 Global Competitiveness Index of the World Economic Forum (WEF) (World Economic Forum, 2019) ranks Azerbaijan 58th out of the 141 countries reviewed, up from 69th out of 140 in the 2018 edition. It indicates improvements across a wide range of indicators with respect to previous years. In some areas it performs significantly better than the overall rating, such as Labour Market (21st), Business Dynamism (23rd), Product Market (23rd), and Infrastructure (38th), but there are also some areas of concern, for instance Innovation Capability (68th), Information and communications technology (ICT) adoption (73rd), Human Capital (98th), and Macro–economic stability (103rd). Several of these factors are directly related to TT capability.

Another important factor is the disparity in the unemployment rates and the wage gap between men and women, particularly high in the professional, scientific and technical activities (65.5% in 2018 according to figures from the State Statistical Committee (Azstat, 2019). Perhaps the most significant challenge for the development innovation in Azerbaijan is the fact that the country's exports are so heavily dependent on the resource sector. Data from the UNECE IPO report[3] suggest that the country's exports are highly concentrated. For instance, in 2018, 80.7% of the country's exports consisted of crude petroleum, 7.64% of petroleum gas and 2.63% of refined petroleum (Observatory of Economic Complexity (OEC), 2020). The national development strategy, Azerbaijan 2020: Vision for the Future, ascribes great importance to innovation-driven growth. A significant number of measures have already been taken to reach this objective and others are emerging, but more time is needed for these measures to become fully operational and for their impact to be comprehensively measured.

1 https://www.britannica.com/place/Azerbaijan

2 https://www.transparency.org/en/countries/azerbaijan

3 https://unece.org/fileadmin/DAM/ceci/icp/Capacity_building/IPO_launch/IPO_2020_FULL.pdf

The Copyright Agency of the Republic of Azerbaijan was created by Presidential Decree to carry out state policy in the field of Intellectual Property Rights (IPR). Other decrees followed and in 2018 Presidential Decree 222 established the Charter of the Intellectual Property Agency of the Republic of Azerbaijan (Republic of Azerbaijan, 2017). It is to be hoped that this will be an agent for change in the TT System, but progress so far has been limited and much of the work of the agency seems to have been in connection with copyright disputes rather than patents or technology related activities.

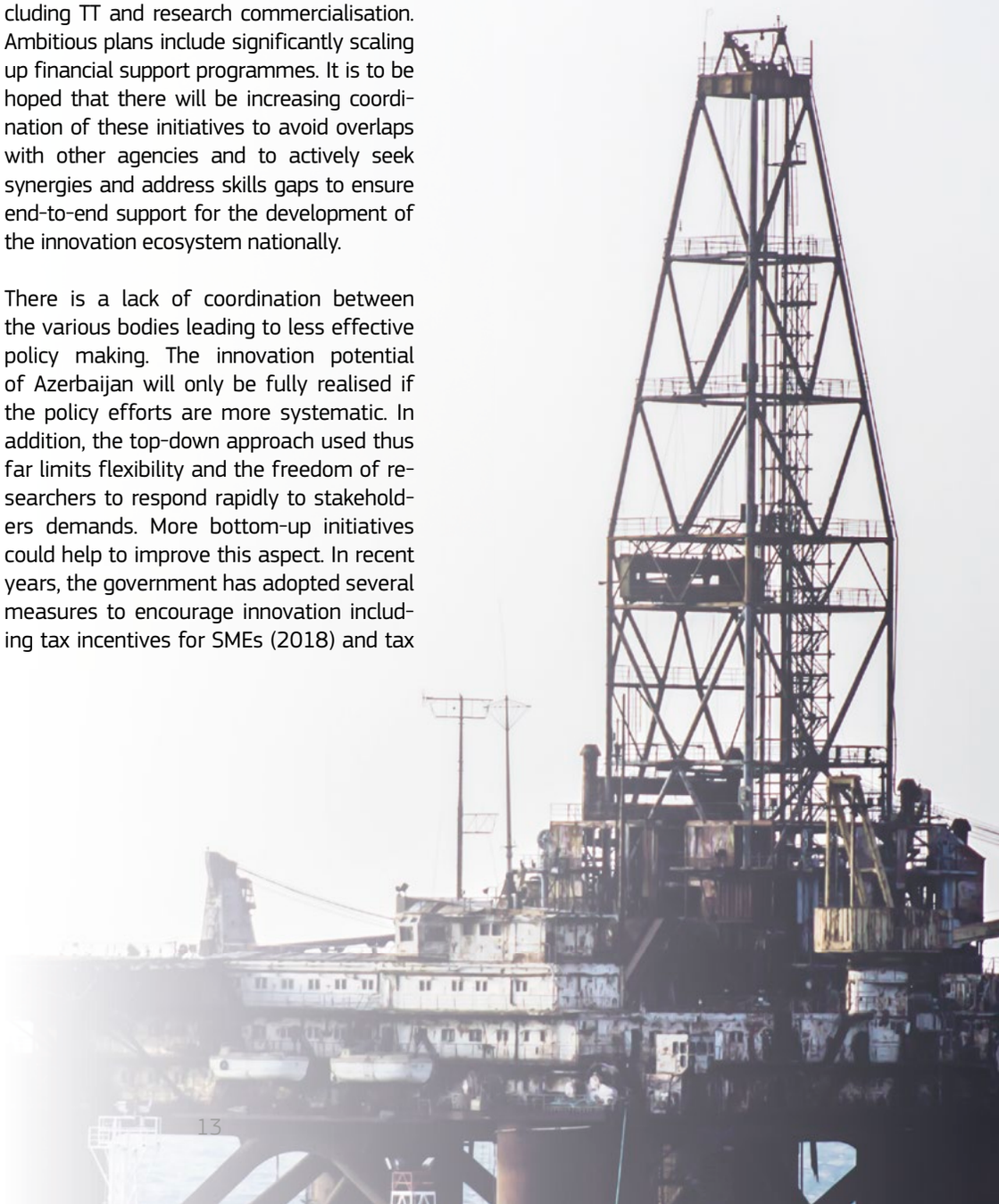
Government funding for research (State Statistical Committee of the Republic of Azerbaijan, 2019) is 0.5% of the government budget, amounting to 0.15% of GDP. A further 0.05% of GDP is contributed by companies bringing the total annual investment in R&D to 0.2% of GDP. Clearly higher rates of investment in excellent research are needed. In general, FDI levels have been strong, but they have been concentrated in the resources sector.

IN 2019 A NATIONAL INNOVATION STRATEGY HAS BEEN PREPARED WHICH SETS OUT GOALS FOR APPLIED RESEARCH FUNDING PROGRAMMES AND POLICY INSTRUMENTS.

Several institutions with responsibility for innovation have also been established in recent years, but they are not yet fully operational, and it is too early to fully assess the results of these measures or the performance of the new institutions. The new policy instruments are to be welcomed, but they need to be consolidated rapidly if they are to contribute significantly to developing and implementing innovation policy initiatives.

The Small and Medium Business Development Agency (SMBDA), set up in 2017, provides direct financial support. It is working with the Ministry of Finance to assist start-ups. Activities undertaken by the agency include support for the national innovation policy, contribution to innovation law and tax legislation. It conducts training programmes and diaspora engagement. Plans include opening regional offices. The Innovation Agency was created in 2019 to provide financial support for innovation including TT and research commercialisation. Ambitious plans include significantly scaling up financial support programmes. It is to be hoped that there will be increasing coordination of these initiatives to avoid overlaps with other agencies and to actively seek synergies and address skills gaps to ensure end-to-end support for the development of the innovation ecosystem nationally.

There is a lack of coordination between the various bodies leading to less effective policy making. The innovation potential of Azerbaijan will only be fully realised if the policy efforts are more systematic. In addition, the top-down approach used thus far limits flexibility and the freedom of researchers to respond rapidly to stakeholders demands. More bottom-up initiatives could help to improve this aspect. In recent years, the government has adopted several measures to encourage innovation including tax incentives for SMEs (2018) and tax exemptions for innovative start-ups (2019). The SME Development Fund SMBDA, the Agriculture Fund and the Innovation Agency Fund all offer funding mechanisms, but the capital markets are not yet sufficiently mature to offer sufficient funding for research, development and innovation (R&D&I) activities. The Department of Innovative Development and e-Government was



established in 2018 to coordinate science and innovation policy initiatives as well as the development of digital government. Chief innovation officers representing each government department meet periodically and this could be an important step toward better coordination of innovation policy, potentially reducing fragmentation and fostering synergies but more efforts are needed in this direction. Although there is no national coordination framework the government has made progress in improving the legal framework for doing business in Azerbaijan and this should help to facilitate more innovation in the private sector. Bankruptcy procedures, business licensing and regulatory impact assessments have all made important strides and streamlined processes and simplified business regulations are positive government initiatives. Intellectual Property (IP) protection mechanisms are well developed but the level of enforcement is a concern. Some important elements of the innovation ecosystem such as start-ups are not consistently defined in the legal framework and there is a lack of clear regulations governing Venture Capital (VC). Insufficient use has been made of Public Procurement as a driver of TT and Innovation. Given the high proportion of GDP represented by government spending (30% in 2019) more could be done using instruments like Pre-Commercial Procurement and Public Procurement of Innovation. Given the work already done at the European level on the development of these instruments, they could be adopted rapidly and with potentially significant impact on the innovation ecosystem.

Universities and research organisations

The Azerbaijan research system includes various actors including the Azerbaijan National Academy of Sciences (ANAS), which is the main state research organisation and the primary body that conducts research and coordinates activities in the fields of science and social sciences in Azerbaijan, plus a large number of public and private universities, research organisations and HEIs.

According to government statistics (State Statistical Committee of the Republic of Azerbaijan, 2019) research activities are very fragmented. There are over 130 organisations conducting research and development in Azerbaijan and over 50 HEIs but most scientific publications come from a limited number of institutions. According to World Bank Open Data (World Bank Data, 2019), the number of scientific and technical journal articles published in Azerbaijan rose steadily to reach 679 in 2014 then fell to 395 in 2014 but has recently risen again to reach 761 in 2018. However, many publications are produced only in the Azerbaijani language and so are not easily shared with or reviewed by the international scientific community. To address these concerns, it is vital that the scientific community in Azerbaijan strive to improve the transparency of the peer-review process both nationally and internationally so that truly excellent research can gain the recognition it deserves.

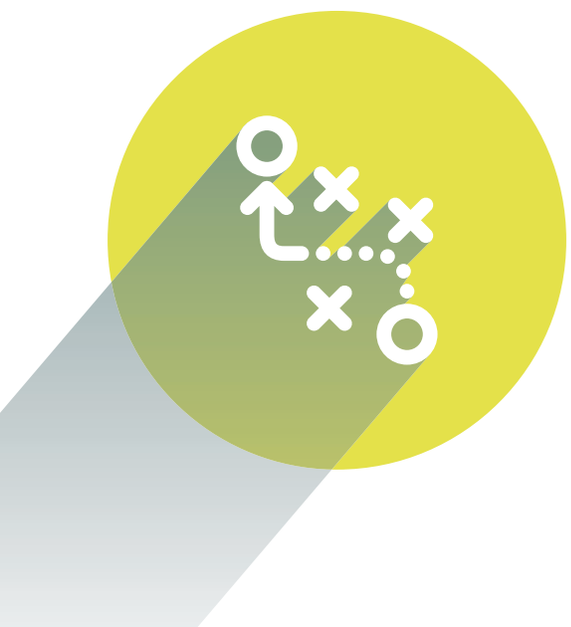
Using an accepted international benchmark of 1.0-1.5 HEIs per million of population (Soete, Mahieu, Luukkonen & Arnold, 2018) the ideal number of HEIs in Azerbaijan would be 10-15. The general impression is therefore that there are far too many HEIs leading to a fragmented system and a dispersion of resources causing chronic underfunding of both education and research. University researchers are not highly paid and so a career in academia is not necessarily the first choice of the brightest students. Concentration of the available resources in fewer institutions could provide the opportunity for specialisation in research excellence, improve links between education and research and enhance collaboration between research and industry. It would also facilitate an overhaul of the salary structure for the academic community to permit more results-driven pay schemes to reward excellence.

Azerbaijan's National Strategy for the Development of Education (2015-2025) recognised the need to invest in STEM education and led to several initiatives in this field. Examples include: a STEM tournament in 2019; a Digital Skills project which began in 2017; the Strategic Road Map for the Development of Vocational Education and Training which was approved in 2016; the Azerbaijan Robotics Engineering Academy; the Ministry of Transport, Communications and High Technologies's (MTCHT) Robopark exhibition project; The World Robot Olympiad Azerbaijan. However, more needs to be done to drive the impact of such programmes and to extend their reach beyond the confines of Baku where most of the initiatives to date have been centred.

The education system shows little sign of alignment with the needs of the business community. Businesses in general and SMEs in particular appear to have trouble finding the talent they need both in terms of quantity and quality, especially in areas such as software development. In education, as in research, government

funding is low compared to international standards and even in comparison to other countries in the surrounding region. There are some international mobility programmes although most of these are entirely funded by external international partners through bilateral agreements between the foreign partners and the Ministry of Education. Students are also provided with grants for education at leading international universities through the President's Youth Foundation. Germany and the United States of America (USA) fund programmes from non-degree to degree and postgraduate level. There are also some examples of bilateral cooperation between specific Azerbaijani HEIs and international institutions.

The overwhelming majority of research (approximately 86%) is conducted by the government with only 9% conducted by HEIs and very little in the private sector (UNECE, 2020). This may be due, at least in part, to limited regulatory support and insufficient investment. Although in some institutions there appears to be a good level of collaboration with industry, for example from the Azerbaijan National Academy of Sciences (ANAS), most of this activity is in the energy sector and once again the lack of diversification presents a serious block to the development of the broader innovation ecosystem. The high level of concentration of research in the public sector and in the ANAS does little to facilitate the kind of diversification that is frequently highlighted in strategic documents as a national priority.



As far as we were able to discern there is at present no national action plan to coordinate research funding and each funding ministry acts independently. Private sector involvement in R&D remains very weak. Contributory factors include funding difficulties, and a lack of awareness within the business community of the research infrastructures and competences available within the research institutes. There seems to be little in the way of coordinated outreach on behalf of the research institutions to engage with industry, and even less effort to identify industry's needs as an input to the definition of research programmes and the development of future research infrastructure and capabilities. More could be done to raise awareness of the research capabilities currently available and to better align future investments and strategic decisions with the needs of the industrial community. This could help to increase the access to and utilisation of research infrastructure by industry and drive collaboration with academia. This is essential if industry is to be involved in increasing the number and quality of collaborative research projects and is a prerequisite to getting higher involvement from the private sector in financing research.

Joint research projects which yield concrete results for industry are the best way to gain buy-in from industry that can eventually lead to increased direct investment in research by the private sector. Unless urgent steps are taken to build trust and develop success stories of collaboration between industry and academia, this will be a long-drawn-out process. This is true not only in the national context but also in terms of international collaboration where the involvement of highly respected international institutions in joint research projects presents significant opportunities to improve capabilities in Azerbaijan's institutions and to build trust between them and the industrial community.

As we were not able to visit Azerbaijan because of the COVID-19 pandemic and our interviews were conducted remotely it was not easy to fully assess the TT capabilities present in the HEIs and research institutions, but the general impression was of limited awareness and understanding of the key principles of TT.

THERE APPEARS TO BE A LACK OF KNOWLEDGE OF THE PROCESSES OF IP PROTECTION AND EXPLOITATION AND LITTLE HANDS-ON EXPERIENCE OF THE COMMERCIALISATION PROCESS.

With few exceptions most of those interviewed had little or no awareness of the existence of specific TT capabilities within their own institutes or elsewhere in the innovation ecosystem. Not all were aware of the existence of some of the measures recently taken, which suggests these need to be better publicised to increase awareness and engagement. Where there was awareness of the existence of national strategies and policies, there was little direct experience of the impact of these policies and very few success stories could be cited.

Very few HEIs have start-up or spin-off company success stories and often the companies that are born remain small single product or niche market companies and struggle to scale-up or make a significant impact in terms of market share, turnover, or employment creation.

Industry

We were unable to find any national studies of TT between public research organisations (PROs) and industry or of innovation capacity in companies in Azerbaijan and we have relied heavily on other data sources. We strongly recommend the government to monitor this area closely to gain a more detailed and comprehensive picture of the present, and to monitor changes in the future as a way of assessing the performance of the measures that have been put in place to drive innovation.

That said, most of the data available suggests that innovation levels are very low. According to a study by the European Bank of Reconstruction and Development (EBRD), the Business Environment and Enterprise Performance Survey (BEEPS V) (BEEPS, 2020), most SMEs reported no innovation during the period studied, so even if more data are needed, we can still draw some conclusions.

As has already been mentioned, the corporate landscape in Azerbaijan is dominated by the oil and gas industry which still makes up a large percentage of the national gross domestic product. While there has been some diversification in recent years, this has not been as fast or as wide as might been hoped and more needs to be done if the economy of Azerbaijan is to become more balanced. Strong industrial productivity gains in the first decade of the 21st century were well above the average for Central Europe and the Baltics but they were based largely on investments in capital intensive resource industries, and in the second decade productivity has dropped significantly (OECD, 2020). In the same period productivity in the service sector has remained stubbornly below the average for Central Europe and the Baltics and the value added in manufacturing, at a constant level of around 5%, remains lower than that of neighbouring countries (OECD, 2020).

One of the problems that industry is facing is the attraction of skilled workers.

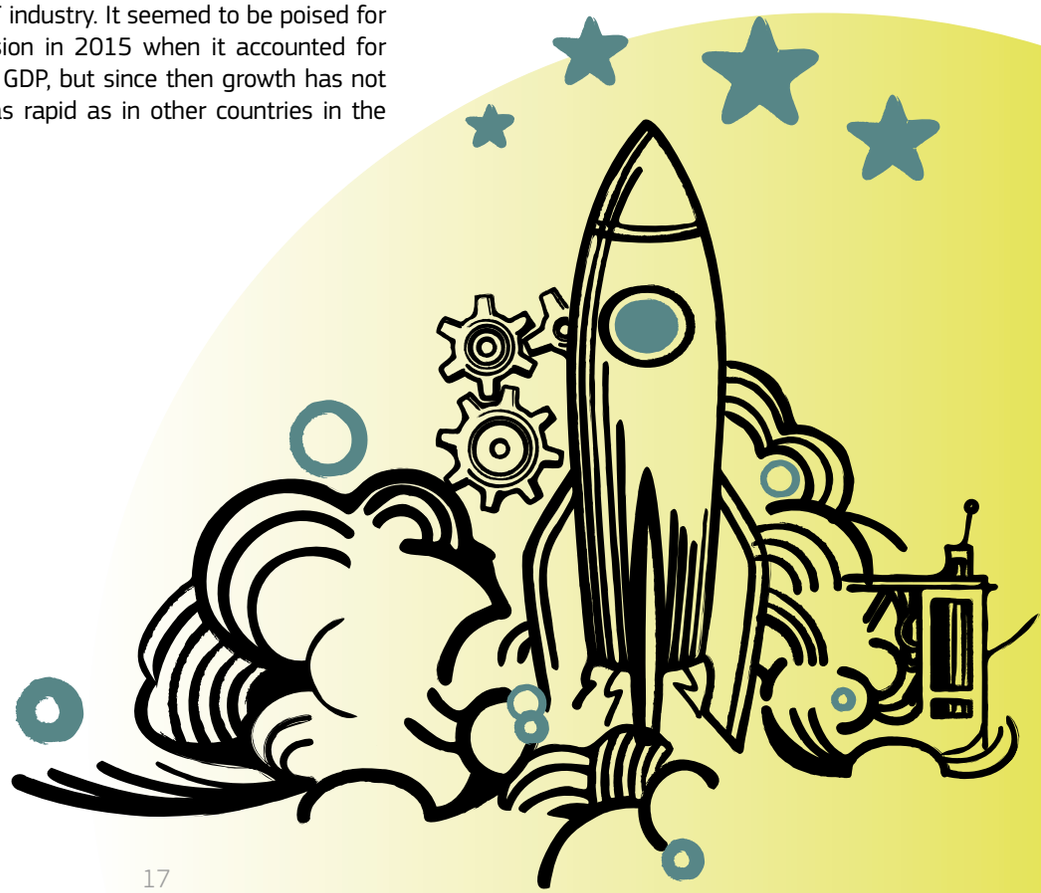
MANY OF THE WORKERS AVAILABLE ON THE JOB MARKET WERE TRAINED TO WORK IN SPECIALISED INDUSTRIES AND THEIR SKILLS ARE NOT READILY TRANSFERABLE INTO OTHER SECTORS, THUS CREATING A BARRIER TO INNOVATION IN THE ECONOMY GENERALLY.

As mentioned earlier, HEIs have not yet done enough to adapt their offering to meet the needs of industry both in terms of supplying graduates with the right skill sets and in terms of opportunities for partnerships with industry.

A sector which had shown early promise is the ICT industry. It seemed to be poised for expansion in 2015 when it accounted for 2% of GDP, but since then growth has not been as rapid as in other countries in the region and given the strategic importance of ICT as a Key Enabling Technology, this lag is potentially damaging for the rest of the innovation ecosystem and for the economy. Clearly this is a sector in which more investment, both from the public and private sectors, could yield significant returns.

Azerbaijan recently secured two elected positions at the International Telecommunication Union (ITU) during the ITU Plenipotentiary Conference 2018 (PP-18) in Dubai.

It is to be hoped that this public commitment will signal important investments that will herald significant improvements in digital connectivity and the development of the ICT industry in Azerbaijan.



Support organisations

Up until a few years ago the support network for innovation in Azerbaijan was limited but in recent years there have been several new initiatives and some promising support organisations have been created. The most significant are highlighted here but our principal observation is that more time is needed to fully assess the impact of these recent initiatives. The creation of dedicated agencies is an important step forward, but it is equally important to ensure that they are appropriately staffed and funded and that their efforts are coordinated to ensure an optimum impact on the innovation ecosystem. The Azerbaijani government is to be commended for moving forward on their agenda to create a knowledge-based economy, but vigilance and transparency will be needed if these early steps are to deliver on their promise and make the hoped-for contribution to innovation in Azerbaijan and the region.

Other initiatives include annual events to sustain innovation and entrepreneurship such as InnoWeek and InnoFest. These measures should be monitored closely, and metrics established to measure their success and the return on these investments.

A SMALL NUMBER OF BUSINESS ANGELS ARE LOCATED IN AZERBAIJAN THOUGH DEAL FLOW IS LIMITED.

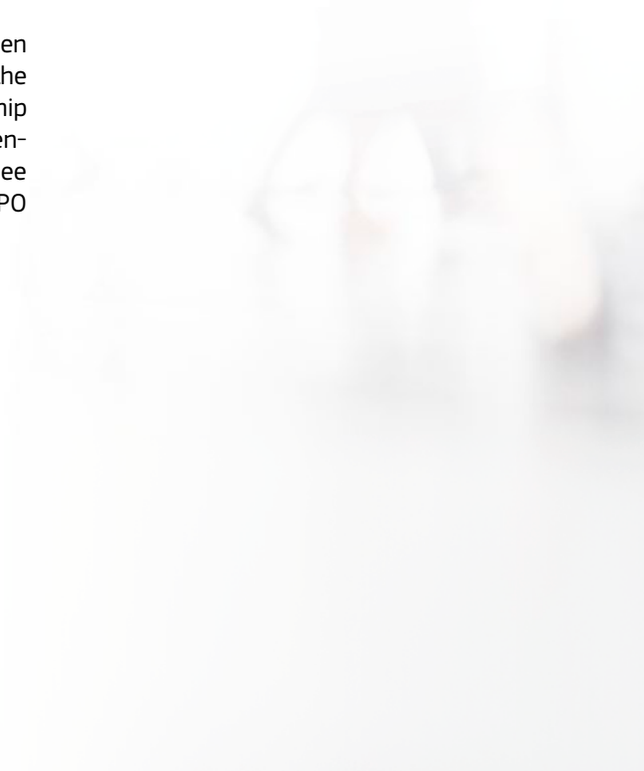
Angel.co lists three individuals located in Azerbaijan with a total of thirteen deals between them[4]. A VC industry is beginning to emerge in Azerbaijan but in this case too, it is not yet sufficiently embedded in the ecosystems to fully evaluate whether its development will continue and will have a significant impact on innovative development. In countries with strong research capability and an established entrepreneurial culture, the injection of investment capital can be the missing ingredient that leads to an explosion of innovative development and economic growth, but unless the systemic issues concerning the research outputs and the entrepreneurial culture are addressed, capital on its own is unlikely to solve the problem. There is some private sector support in the form of sponsored events like hackathons and innovation competitions from larger companies such as Azerfon, AzerTurkBank, PASHA Bank and Procter & Gamble.

Several technology incubators have been established in recent years including the Barama Innovation and Entrepreneurship Centre of Azercell Telecom. For an extensive list of incubators and accelerators see the table at page 147 of the UNECE IPO (UNECE, 2020).

Business plan and start-up competitions include the National Innovation Challenge of the Ministry of Economy and "From Idea to Business (I2B)", a joint project with the MTCHT. These competitions provide visibility and some funding but follow up and mentorship programmes are often lacking. Other initiatives include the MAINTECH innovation and technology forum, the Caspian Innovation Conference organised by the MTCHT and the annual exhibition of IT – Innovations and High Technologies Bakutel.

There were 12 business associations registered in Azerbaijan in 2019 providing some business and entrepreneurial training but specific TT related services are not evident.

The ANAS High-Technology Park was established by a Presidential decree in 2016 with a specific mandate to drive scientific and technological innovation. Five industrial parks are also registered as sector-specific manufacturing compounds but for the most part these offer space and physical infrastructure and not TT related services, though some do offer incubation and consulting services.



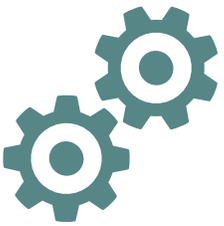
4 https://angel.co/azerbaijan/investors accessed in December 2020

An interesting actor in the innovation space is the self-funded Innoland Incubation and Acceleration Centre, which houses the SUP accelerator, Next Step and Khazar Venture and is a public-private partnership which co-funds start-up projects. It has several main investors based in Silicon Valley, some of which are members of the Azerbaijani tech diaspora.

Engagement with the diaspora has begun to improve with several government schemes developing to strengthen networks in recent years. In 2018, the first summer camp for Azerbaijani living abroad was run and a Diaspora Youth organisation was established the same year. To improve cooperation among diaspora organisations coordination councils have been established in numerous countries including numerous European states.

The State Committee on Affairs with Diaspora helps to integrate Azerbaijanis living abroad and the SMBDA supports innovation-related engagement of the diaspora. In 2020 the Innoland Incubation and Acceleration Centre opened the Azerbaijan Innovation House at Stanford University in Silicon Valley.

Key points of technology transfer activity in the country



The innovation ecosystem is still evolving and TT activity is limited. There are some technology transfer offices (TTOs) and Industrial Liaison Offices in the research Institutions, but staff levels are low and skill sets are limited. Insufficient training has been provided on TT specific activities and the level of professionalism could be improved through better training and more access to international best practices. Despite the numerous initiatives that have been activated in recent years there is still an evident shortage of TT professionals with the full range of skills necessary to fully develop and sustain the national innovation ecosystem. University-industry collaboration exists but is limited and primarily driven by government funded programmes and the oil and gas sector. Low private sector involvement and low diversification means that hopes of significant strides in innovation capability are often left unfulfilled.

According to World Bank Open Data (World Bank, 2020), the number of patents produced in Azerbaijan is still relatively low. In 2007, 287 patents were deposited by residents of Azerbaijan while this fell to 200 in 2019.

The most recent Word International Property Organization (WIPO) Statistical Country Profiles show that the success rate for Azerbaijan patent filings is also modest with only 120 of the 200 filings by Azerbaijan residents approved in 2019 (WIPO, 2019). 75% of the 20 patent filings by non-residents were approved in the same period. The overwhelming majority of patents filed by residents are local with only one resident application for an international patent versus 16 non-resident Patent Cooperation Treaty (PCT) applications.

DESPITE THE LARGE NUMBER OF ACADEMIC INSTITUTIONS AND THE SIGNIFICANT NUMBER OF RESEARCHERS ACTIVE WITHIN THEM, AZERBAIJAN IS NOT AS FULLY ENGAGED WITH THE INTERNATIONAL SCIENTIFIC COMMUNITY AS IT COULD BE.

Lack of trust between industry and academia and a lack of engagement on both sides severely reduces the number of opportunities for university-industry collaboration, resulting in limited success stories based on the kind of positive experiences needed to build confidence and kick-start a virtuous circle of development.

A track record of poor governance, a lack of diversification and insufficient investment have created a context in which it is difficult for the new agencies and organisations, tasked with improving TT activity and building the innovation ecosystem, to have the desired impact. Professional skill acquisition and successful communications campaigns will be necessary to build an environment that will be fertile ground for future collaboration. The private sector is likely to remain sceptical until it witnesses internationally acknowledged excellence in the outputs of the research community, which could inspire them to engage more with academia to resolve their industrial challenges through research-based technological innovation.

Knowledge diffusion is improving but more work is needed in developing linkages between research and industry. This means stimulation packages to create and nurture these collaborations will be needed and then proactive communications strategies to make them well known and to encourage others to follow suit. Early-stage investment remains an issue and will most likely require significant public intervention to initiate the process before private sector capital will get involved. Countries that have adopted public-private partnerships to stimulate the provision of risk capital while offering some protection to investors can be used as case studies and examples of best practice in order to adopt similar measures.

Skills building programmes like the management training programme being run in partnership with the German Development Agency for International Cooperation (GIZ), will be key to building the competences necessary to accelerate Azerbaijan's passage to becoming a knowledge economy.

Many positive developments which have begun in recent years have yet to bear fruit but the commitment to their implementation will be key to their success, and expectations of what can be achieved should be realistic to avoid over-promising, leading to disillusion and the risk of de-funding important initiatives before they have had a chance to consolidate their position and provide results. Clear and realistic metrics should be established to measure the evolution of these initiatives over time and coordination between the various agencies will be key to optimise their performance.

The roles and functions of the various new agencies and the other actors in the innovation ecosystem are not yet fully developed and there is always potential for overlapping responsibilities, duplication, or gaps in the process, but if attention is paid to coordination of these various agencies and programmes and best practices are adapted to the Azerbaijan context, then there is significant potential for improvement and growth.

RECOMMENDATIONS

Ecosystem

- It is vital for the development of a TT culture, that Azerbaijan adopts proactive measures to accelerate diversification of its industry and exports. This will require investment but in the medium to long term will yield a significant return both in terms of direct economic impact and by providing more and increasing opportunities for collaboration and innovation.

- Make sustainable development a priority, thus addressing some international concerns about Azerbaijan's contribution, as an oil and gas driven economy, to climate change, but also providing numerous opportunities for research driven innovation.

- More bottom-up processes should be developed to ensure the voices of a variety of industry sectors are adequately represented in the policy making process to foster TT.

Innovation policy

- Improve policy setting and strategic planning through a concerted effort to gather data consistently and transparently both on the current state of TT and innovation and on the impact of the various measures activated to improve it.

- A clear and coordinated approach to public procurement of innovation should be a priority. Stimulate public-private partnerships in a variety of business sectors and provide more opportunities for the private sector to participate in the definition of priorities for public sector investment in research infrastructure.

- A centralised coordination of science and innovation policy would be useful to address the problem of fragmentation of the innovation ecosystem in Azerbaijan.

- Ensure that the fledgling Coordination Council for Science and Innovation Policy becomes fully operational and adequately resourced so that it can better coordinate national innovation policy.

- Funding is a significant issue for Research Development and Innovation. Clearly resources are finite and not all requests for funding can be satisfied so priority setting and targeted funding will be essential in driving up excellence and creating self-sustaining sectors for the future. Foresight exercises and processes like Smart Specialisation Strategy (S3) can assist in making these choices.

- Form stronger international partnerships with foreign research organisations and HEIs to encourage collaborations on education (joint degrees) research, joint publications and industry collaboration.

- Increase international collaborations by assisting institutions and researchers with project presentation. This can be done by providing information on relevant calls, assisting with partner identification and acquisition, technical assistance in structuring winning project proposals, providing a fast-track process for reviewing draft project proposals before their presentation to facilitate improvements.

- Continue to develop initiatives to involve the diaspora in developing the innovation ecosystem.

- Eliminate overlaps and duplication in service provision from incubators, accelerators and high technology parks to streamline the system and provide end-to-end support.

- Though many important initiatives have been launched in recent years there appears to be insufficient awareness of them across the innovation ecosystem, so we recommend a sustained awareness campaign to communicate to all stakeholders the existence, roles and opportunities provided by each of the new actors. This campaign should also increase public awareness nationally and internationally of the government's commitment to improving the innovation ecosystem of Azerbaijan.

R&D infrastructure

- Create a small number of Centres of Excellence where research infrastructures can be concentrated, and which reflect the strategic priorities of the country and the sectors in which it wishes to stimulate diversification and innovation. These centres should be few and highly focused to ensure adequate resources are made available and to avoid dispersion and dilution of effort.
- Make better use of the extensive research infrastructure already available and guarantee access for industry. Use international best practices as models to develop open access approaches to stimulate industry use of public sector research infrastructure and capabilities.

SMEs and start-ups

- Continue on the path already taken of addressing governance issues to enable businesses, in particular start-ups, to be established and to scale up with the minimum of red tape and bureaucracy.
- A clear definition of "start-up" must be adopted across the board to ensure coherent policymaking.
- Improve and accelerate the adoption of digital technologies across the board.

Technology transfer

- Technology commercialisation is scarce and needs to be developed as a professional skill set.
- Development of IP from residents should be encouraged.
- Tools like Technology Foresight, Scenario Planning and Strategic Technology Roadmaps should be fully integrated into the policy making process.
- Specific capacity building programmes should be undertaken to ensure adequate skill levels are acquired in all areas of TT across all the existing and emerging TT actors, including University TTOs and Industrial Liaison Offices.
- Skills in TT require significant upgrades. Investment is needed in training and partnering with international organisations to provide capacity building.
- Technology Readiness Level (TRL) assessment processes should be developed in all institutions to better enable technology scouting.
- Spin-off programmes should be enhanced to encourage researchers to engage in entrepreneurial activity and commercialisation of their research results.
- Further incentives should be made available to encourage industry-research partnerships across a range of technology areas and industry sectors with particular emphasis on key enabling technology areas of strategic interest.
- Open Innovation approaches should be taught across industry sectors to highlight the benefits and TT between companies as well as between researchers and industry should be incentivised.
- Patent information is underutilised hence the use of existing Patent Libraries and more generally knowledge of patenting processes and patent information research should be more widely disseminated.

Human resources/ competences

- Training programmes are needed to increase capacity and professionalism in all sectors.
- Increase mobility of researchers through greater participation in international programmes.
- Continue to drive improvements in the education system and conduct a systematic analysis of business and other stakeholder needs, so that comprehensive reforms of the education system can reflect demand and not be only driven by the supply side of the equation.
- Existing efforts to support STEM education should continue and be built upon.
- International collaboration opportunities on development of education programmes should also be explored.

- Send staff on international study tours for periods of time long enough from them to acquire expertise in key areas where skills are currently lacking e.g., technology commercialisation.

- Increase Azerbaijan's participation in international collaborations and European projects to provide more opportunities for Azerbaijan's scientists and researchers to work with international peers and compete internationally for funding.

Funding

- Increase the concentration of resources in fields of high strategic importance, for instance by providing funding to co-finance collaborative research in strategic areas.

- Co-finance research projects that aim to meet the needs of specific industry sectors. Involve representatives of industry in setting the priorities and evaluating the proposals from the research community.

- Reward research excellence through highly selective programmes in key fields that stimulate the development of research capability in strategic areas.

- We have heard numerous times in the interviews that there is a lack of success stories that can be held up as examples. We therefore recommend a highly competitive process of selection of a small number of pilot projects to be well funded and fast-tracked so that those which are successful can become examples and an inspiration to others to embark on the path of innovation.

- Enable public-private collaboration through a "fund of funds" to provide risk capital to early-stage innovative businesses.

- Involve international donors in the funding instruments for start-ups.

- Though much has already been done better legal frameworks are still needed in areas such as insolvency and VC.

- Co-finance Proof of Concept (PoC) programmes which involve both research institutions and industry.

- Increase early-stage funding for start-ups but make it highly competitive to reward excellence.

- Once an excellent start-up has begun its journey by winning early-stage finance ensure that there are follow on services such as mentoring, product development, market assessment and communication strategy and IP management to assist them in becoming investor ready for the larger venture rounds.

Monitoring and KPIs

- More accountability and transparency will help to ensure that once funding is made available it is utilised effectively and efficiently. This will require constant monitoring not just of activities but of results and their impacts.

- Appropriate metrics and Key Performance Indicators (KPIs) should be developed for continuous monitoring of all initiatives so that over time they can be optimised. Monitoring processes should go beyond the observation of activities and measure the results obtained and their impacts.

- Link future funding measures to performance improvements and develop metrics to monitor these improvements.

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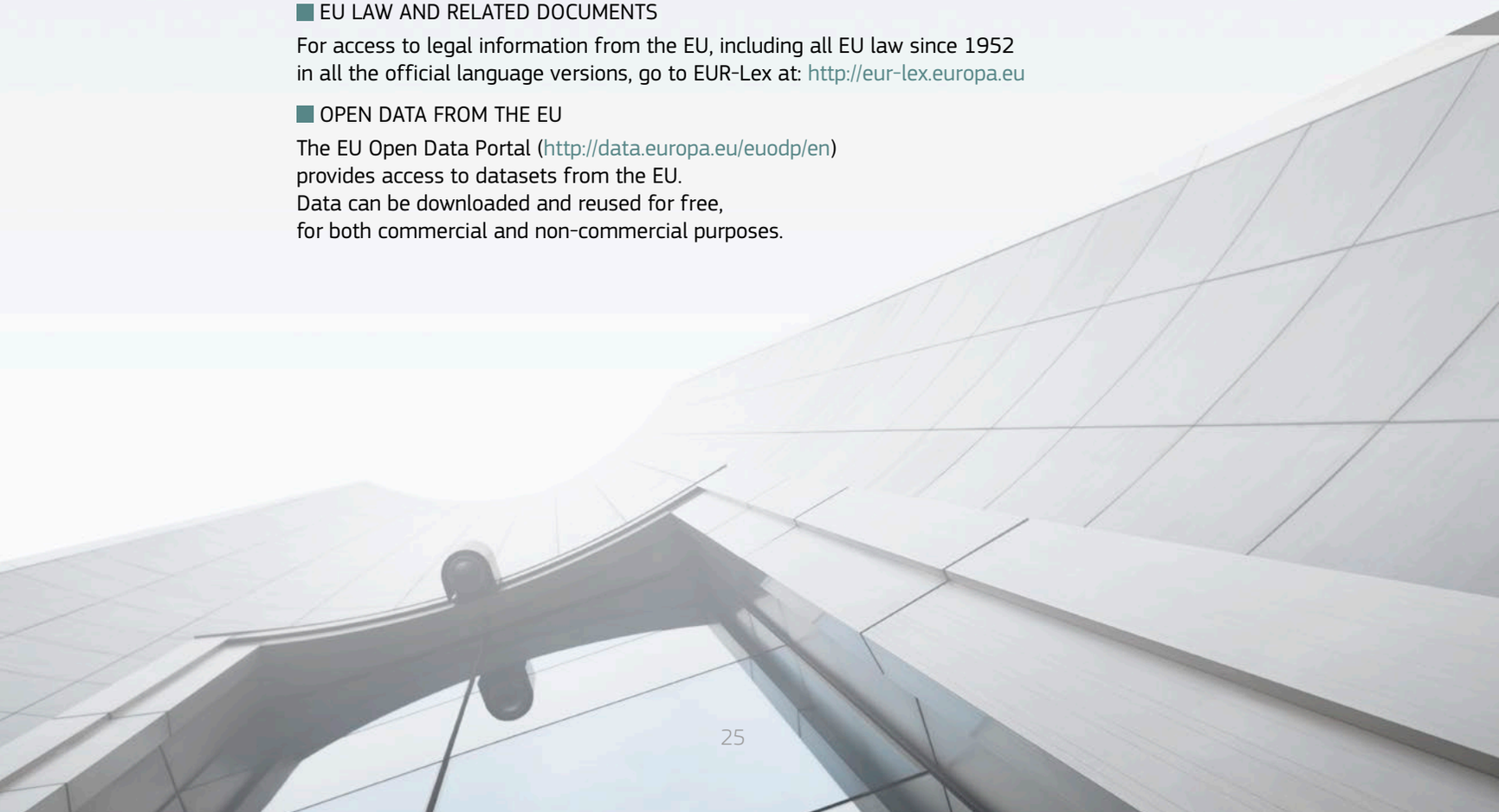

Acronyms

ANAS	Azerbaijan National Academy of Sciences
BEEPS	Business Environment and Enterprise Performance Survey
EBRD	European Bank of Reconstruction and Development
EU	European Union
FDI	Foreign Direct Investment
GCI	Global competitiveness index
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
HEI	Higher Education Institution
ICT	Information and communications technology
IP	Intellectual property
IPR	Intellectual property rights
ITU	International Telecommunication Union
KPI	Key performance indicator
MTCHT	Ministry of Transport, Communications and High Technologies
OEC	Observatory of Economic Complexity
OECD	Organization for Economic Co-operation and Development
PCT	Patent Cooperation Treaty

PoC	Proof of Concept
PRO	Public research organisation
R&D	Research & Development
R&D&I	Research, development & innovation
SMBDA	Small and Medium Business Development Agency
SME	Small and medium enterprise
S3	Smart Specialisation Strategy
STEM	Science, Technology, Engineering and Mathematics
TRL	Technology readiness level
TT	Technology transfer
TTO	Technology transfer office
UNECE	United Nations Economic Commission for Europe
UNECE IPO	UNECE Sub-regional Innovation Policy Outlook
USA	United States of America
USD	United States Dollar
VC	Venture capital
WEF	World Economic Forum
WIPO	World International Property Organization

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