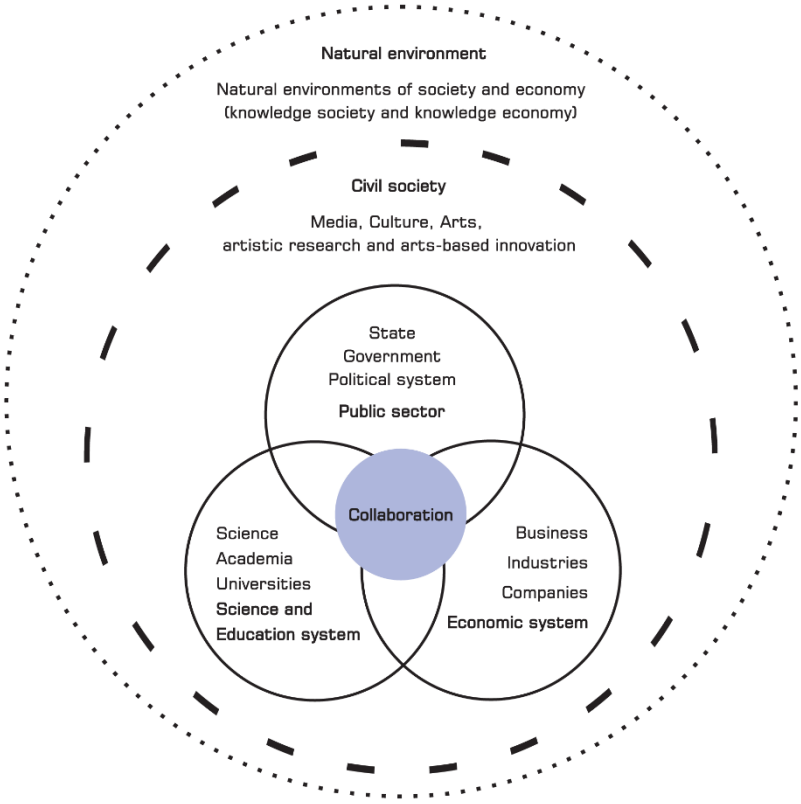
ევროკავშირი საქართველოსთვის
Project funded by the European Union

TWINNING

EU Twinning project
"Supporting inter-sectoral collaboration possibilities between Research and Industry"

Synthesis report v1.2.

Identification and setting of scientific priorities in Georgia



The quintuple helix of innovation model

Component 1 Science - business links strengthened through supportive collaborative activities and funding schemes
Activity 1.2.1. Identification and setting of scientific priorities

umweltbundesamt JOANNEUM RESEARCH DLR Projektträger FWF Der Wissenschaftsfonds. FFG

Contents

This report was created with the support of the European Union, which does not necessarily mean that it reflects the views of the European Union. Only project partners are responsible for the content of the publication.

Introduction

Purpose and content of the report

This report briefly describes a concept of priority setting process in the framework of the TWINNING Project - Supporting inter-sectoral collaboration possibilities between Research and Industry (ENI/2020/414-971) in Georgia and the main building blocks of this process, i.e. the socio-economic environment in Georgia, the actors of the national STR system and interactions. The next chapter some stylized facts about the **Georgian socio-economic environment and innovation system**. The **STI priorities Georgia** described in the last chapter of this policy paper are based on the outcomes of the *Priority Setting Workshops held between April and May 2022*. The overall objective of the project is to address the priorities and challenges in Georgia's Science, Technology, and Innovation (STI) system to ensure an interdisciplinary approach, and collaborative research and promote evidence-based policy implementation in line with the EU-Georgia Association Agreement (AA). Furthermore, the workshop aims at demonstrating the main differences between science funding by means of thematic priorities and prioritization through scientific disciplines (i.e. science fields) and defining concrete thematic priorities based on the strengths and opportunities of the Georgian STI system Chapter 3 describes the structure of the STI priorities set, including the outcomes of the prioritization workshops and the potential use of STI indicators and the challenges they pose in specific contexts. Priority setting should not be considered in isolation from the broader context of S&T policy; priority setting is only one part of a broader process of developing an S&T strategy. It also describes policy processes and ways in which the STI prioritization process can be taken forward.

How to define priorities in the field of Science, Technology, and Innovation Policy

To define priorities in the field of Science, Technology and Innovation Policy STI stakeholders have to reach a clear understanding of the key strengths and weaknesses of their innovation systems and identify strategic priorities and policy options for their development. Priority-setting in RTD policy has become an issue of major concern in most OECD countries, and in particular in the EU where the emergence of the European Research Area has triggered a debate on the (re-)focusing of national research and technology portfolios. However, the outcomes and processes of priority-setting differ significantly across countries, and most governments are in search of good practices of priority-setting. The practices in terms of policies, instruments, and institutions may differ considerably due to national cultures and historically grown characteristics, and the rigidities of the institutional framework and of organizational settings are such that path dependencies can hardly be avoided. Still, one can observe an overall „prioritization logic" in the changing contexts, rationales, and approaches of priority setting in R&I policies in Europe. The priority setting in R&I policies is followed by two main lines aiming to facilitate improved priority setting: better understanding of the wider innovation policy context of R&I Strategies for Smart Specialisation (RIS3), and making better use of Strategic Policy Intelligence (SPI) and other support tools (including learning from private sector strategies) to structure and guide policy cycles, and to implement place-appropriate policy mixes.[1]

[1] Clar G, (2018) Guiding investments in place-based development. Priority setting in regional innovation strategies JRC Report, EU Commission, JRC nr: JRC112689

Priority setting and innovation (policies), competitiveness, the concentration of resources

Rightly, priority setting is considered a persistent challenge (OECD 2007) in any policy area, but it is equally true that good priority setting is a key aspect for enhancing the quality and effectiveness of policies and strategies, and for increasing return on public and private investments. Regarding the current EU Cohesion Policy (CP), the prioritization of strategic areas for innovation-oriented investment - through comprehensive place-based analyses and "Entrepreneurial Discovery Processes" (EDP) - is the core aspect of the Smart Specialisation (S3) approach. Priority setting is a multifaceted challenge, and concerning research and innovation (R&I) challenges concern i.a.: the type of strategic processes implemented (tools and continuous nature), the priorities (focus, granularity, and nature) selected and positioned vis-à-vis global value chains (GVC), the territorial governance and capabilities, the actors to be involved, their R&I, strategic and methodological competences, their understanding of innovation, and their experience with the broad spectrum of innovation boosting tools. Truly understanding innovation (policies), and taking the appropriate, place-specific measures for implementing related policies are vital; the importance has been stressed through decades in international settings, countries, and regions.

Various projects of the EU or the Technology and Innovation Policy Working Party (TIP) of the OECD had this focus, and their recently finished exercise[2] opens by saying: "*The demand for innovation among policymakers has never been greater and more purposeful.*" At the EU level, a long list starts with the "Green Paper on Innovation[3]" (EC 2009) and has certainly not come to an end with the 2017 Communication "Strengthening Innovation in Europe's Regions[4]" (EC 2017a). The latter cites, e.g., the "White Paper on the Future of Europe[5]" (EC 2017)b stating that innovation is recognized as one of the main economic drivers for boosting jobs, growth, and investment. Given the close correlation between R&D performance and economic performance (comparing the results of the "Regional Innovation Scoreboard" and the "EU Regional Competitiveness Index"; or analyzed by OECD in 2015), it is all the more disquieting when aiming at "resilient, inclusive and sustainable growth", that the competitiveness and innovation divide between some advanced EU regions and less strong regions is widening.

When research and regional policies work closely together to encourage knowledge absorption, it will be easier for lagging regions and countries to diminish the gap towards the technology frontier[6]. With their strong focus on R&I in the 2014-2020 programming period, the European Regional Development Funds (ERDF) aim to reduce this divide and to boost investment impact on competitiveness and broader benefits across the EU. Towards this larger aim, R&I Strategies for Smart Specialisation (RIS3) are a means to concentrate (co-) investments in place-based activities, which are well-positioned vis-à-vis GVCs, and also related to territorial or sectoral strategies outside of the region. Recent assessment and status reports (see below) show that, so far, the concentration of investments has not everywhere been optimally achieved. Many of the reasons often cited relate, either directly or indirectly, to priority setting and the types of priorities selected for innovation-oriented investment, a key element of the S3 policy concept.

[2] OECD (2016) Innovation Policies for System Transformation

[3] EC (2009), Green Paper on innovation. Document drawn up on the basis of COM(95) 688 final

[4] EC (2017) Strengthening Innovation in Europe's regions - Strategies for resilient, inclusive and sustainable growth

[5] EC (2017) White Paper on the Future of Europe

[6] Aghion P., Jaravel X., (2015), Knowledge Spillovers, Innovation and Growth

Actors in the innovation system Innovation

Innovation is a process of discovering better ways to arrange productive resources to address individual or social needs. This process is brought about by firms and other actors who interact within learning networks, and through linkages that enable actors to learn by interacting. To better benefit from STI (including with a focus on the SDGs), there is a need to recognize the roles and capabilities of all key actors in the innovation system:

- Firms and entrepreneurs have the capabilities to learn, absorb, innovate and commercialize new knowledge and technologies with an innovative effect.
- Research and education systems have the capabilities to learn, absorb and develop new applied knowledge, and to supply human capital to the innovation system.
- Intermediary organizations have networking and coordinating capabilities, and the capabilities to identify relevant knowledge, as well as to support knowledge transfer, and management capabilities.
- Consumers/users have the capabilities to learn, test, and adapt new technologies, altering practices to support or constrain systemic change.
- Civil society and citizens have the capabilities to challenge non-inclusive and unsustainable practices, form alliances to lobby for change, mobilize and drive innovation, and pioneer solutions.
- And last, but not least, the government has the capabilities to mediate innovation priorities, direct public resources into priority areas, support capabilities and connections in the innovation system, remove obstacles to innovation, influence the incentive structure, define and enforce regulations and standards, and attempt to improve framework conditions through public policies.

Firms and entrepreneurs are at the core of the innovation system. They have a central role in connecting different types of knowledge to bring innovative technologies, goods, and services to the market. They need to continuously increase their capacity to identify, adopt, assimilate and diffuse existing knowledge and technologies. This technological learning is not limited to formal mechanisms of R&D. Learning by doing and by interacting with users, clients and suppliers plays a critical role in many contexts. Firms are not the only innovators and they do not innovate in isolation. In developing countries with emerging innovation systems, the private sector may be dominated by small and micro enterprises. The informal sector is often relatively larger than in advanced economies. Start-ups in modern production activities outside the informal sector may be few and find little support. The majority of firms and other actors need to develop a basic capacity to learn how to articulate demand for, as well as adopt, assimilate and diffuse, existing knowledge and technologies. In this process, they need to act as knowledge producers, not just passive knowledge users, and use foreign inputs to develop their innovative solutions. Building absorptive capacity and technological upgrading often rely on access to, and assimilation of, foreign knowledge and technology by local actors.

The research systems are also crucial to innovation. Researchers can offer various supporting services, from testing new technologies to fully fledged R&D. Their ability to learn and apply knowledge to innovation processes is critical to technological learning and building the local knowledge base.

Intermediary organizations help mitigate a fundamental systemic failure regarding the connection between the generators of scientific and/or technological knowledge and knowledge users among the other players in the system. The education system improves the quality of human capital available to firms, governments, and research institutions. A modern education system should be relevant to the changing needs of industries, workers, and consumers, and the challenges of Sustainable Development Goals.

Civil society, non-governmental organizations, social enterprises, and engaged citizens are crucial for focusing STI policy on meeting societal challenges. Civil society can mediate between technology developers and marginalized groups and promote innovations that address their needs. In developing countries, civil society

can be instrumental in testing, promoting, and diffusing innovations designed to benefit the most disadvantaged communities.

And last but not least, the government is key to establishing a consensus on development and STI policy priorities, directing resources towards these goals, fostering capacity building and the creation of linkages in the innovation system, and promoting collaboration across government and with other key actors. They can remove bureaucratic, regulatory, or monopolistic obstacles to innovation and adjust the incentive structure as appropriate, all while aiming to improve framework conditions through policy actions. A coherent STI policy mix is crucial to providing a stable and predictable environment for innovation. Establishing a national STI agenda, tackling institutional and regulatory issues that delay innovation, and fostering the creation of entirely new markets in priority areas should be the main objectives.[7]

The connections and relationships between actors are a vital component of any innovation system. Effective innovation systems have robust and evolving network connections that enable organizations to translate new knowledge into innovations and enhance production capacity. Networking and collaboration capabilities are key to enabling the adoption of technology, learning, and new technology development. They aid also the flow of key resources, including finance and human capital. It is precisely the link between firms and entrepreneurship and other actors in the system which is missing in many developing countries[8]. Effective innovation systems encourage local, national and international collaborations that cut across economic sectors, technology areas, and scientific disciplines. Collaborations along supply and value chains, including organizations financing innovation and the final users of new technologies, ensure that innovation responds to demand, is socially accepted, and has a chance to succeed on the market. Developing links with foreign firms, funders, and research centers is a key step for developing countries with an underdeveloped local knowledge base and limited access to market intelligence. Innovation collaboration can occur spontaneously, but in many innovation areas, notably related to addressing social and environmental challenges, it needs to be actively facilitated by the government or other actors, notably non-government organizations (NGOs). Government can support networking in specific locations (e.g. technology parks) or sectors (e.g. competence centers focused on specific topics).

Thematic Priorities and Science fields

It is important to understand the differences between the concept of funding by thematic priorities and by science fields (or scientific disciplines).

Scientific thematic priorities address research needs from Society and/or the Business Sector and aim at fostering collaborative actions of industry and the science sector. As they aim at specific identified problems they can also help to overcome existing silos in the science sector. In terms of implementation, they inform funding programs, e.g. Horizon Europe (EU), and are reflected in the respective work programmes.

Science fields refer to classifications such as the OECD Frascati classification of science and technology (FOS), the UNESCO nomenclature for fields of science and technology, or Scientific disciplines in bibliometric

[7] Chaminade and Padilla-Perez (2014) Regional innovation systems in developing countries: Integrating micro and meso-level capabilities

[8] Lundvall et al. (2009) Innovation system research and developing countries

databases (Web of Science, Scopus). They Structure science into branches and are also a unit of analysis for the assessment of productivity and for benchmarking in science by branches (i.e. bibliometrics).

The following table summarises the advantages and disadvantages of each approach in its relation to the funding of science:

	Funding by Thematic Priorities	**Funding by Science Fields**
Advantages	• Very good ability to adapt to emerging trends • Strong potential to address challenges from society and/or the business sector • Strong potential to promote private sector investments in R&D	• (Relatively) stable framework • No initial consultative effort needed
Disadvantages	• A big initial effort needed to identify relevant priorities • Need periodic adjustments (every 7 to 10 years)	• No involvement of the business sector • No possibility to fund interdisciplinary projects • No possibility to address societal needs properly • Difficulty to adopt to emerging trends

Priority Setting in Georgia in previous studies

The technological priorities of the country were looked at in previous studies in 2017. The priorities set are largely in line with the priorities set in the Twinning project. In order to get an overall picture, the previous results of the USAID Policy Mix Peer Review are briefly presented here. According to the USAID Policy Mix Peer Review[9] of Georgia the definition of the priority fields could include two distinct types of fields: (i) Research fields where currently strong research capacity exists, e.g. around best practice examples/infrastructures in the country (mainly biotechnology); (ii) Research fields that are centered around promising economic fields (niches) in the country, e.g. wine industry and other food products; tourism and other services; etc. So the PMPR recommends increasing the role and influence of the Research and Innovation Council headed by the Prime Minister.

The USAID Mix Peer Review[10] of Georgia found prospective projects in the fields of **biotechnology, ICT; materials science, and electrical engineering**.

Biotechnology, in Georgia including phages and the world-class expertise at George Eliava Institute of Bacteriophages, Microbiology, and Virology; emerging fungal-based technologies to generate biomass from agricultural wastes. Among the identified fields with the highest potential for commercialization are: Neither government grants and programs, nor private funding allows funding commercial piloting worth at least USD one million. This gap could have been addressed by a biotechnology center project, however, its planned budget of GEL one million is still below the needed resources. The **high price of scientific equipment** is the first barrier to overcome on the road to the successful commercialization of innovations in the high-tech sectors. Choosing the right equipment to enable full lifecycle support for the innovation process is another important issue needed to be addressed.

[9] PMPR Policy Mix Peer Review (PMPR) of the Georgia STI system. 2015 USAID

[10] PMPR Policy Mix Peer Review (PMPR) of the Georgia STI system. 2015 USAID

Physics applications and materials science, including plasma incineration reactor application for waste management; differential scanning calorimeter (DSC) applications for cancer diagnosis, thermoelectric generators, and nanotechnology powders to be further researched.

ICT and its new emerging fields of the internet of things, big data, and artificial intelligence have not been targeted in Georgia as fields with high potential. However, they could be considered as **crosscutting features and innovative application of ICT** in other (to be identified) priority fields that could bring positive results.

Priorities in R&D policy in Georgia

In advanced industrial economies, science and technology policy always has had a strong focus on promoting the development of specific new technologies that are expected to contribute to societal and economic policy objectives[11]. Despite significant growth of R&D expenditures in developed countries, no single one of them is capable of conducting fully-fledged research covering the whole range of subject areas. Therefore setting sound priorities for science, technology, and innovation (STI) activities becomes particularly important, since they determine the prospects not only for scientific, but also socio-economic development[12].

Thematic priorities

Thematic priorities in the Science, Technology, and Innovation Policy address research needs from Society and/or the Business Sector and aim at fostering collaborative actions of industry and the science sector. As they aim at specific identified problems they can also help to overcome existing silos in the science sector. In terms of implementation, they inform funding programmes, e.g. Horizon Europe (EU), and are reflected in the respective work programmes.

Functional priorities

Functional priorities refer to generic challenges in a national or regional science and innovation system. By doing so they address issues such as technological diffusion, start-ups, academia-business linkages, qualification, IPRs, etc. Functional priorities can complement thematic priorities and may also have a cross-cutting character (i.e. across various sectors or research domains.

Initial priority domains and process of identification

Figure 1 presents a schematic sketch of the steps of a priority-setting process in science policy.

Figure 1: Schematic overview of the process of identification of priorities for science and technology policy

[11] Gassler, H. et al. (2007), Priority Setting in Research and Technology Policy, Historic Developments and recent Trends, InTeReg Working Paper No. 36-2007, p. 3

12 Grebenyuk, A. et al. (2016), STI Priority Setting in the EU Countries and the RussianFederation: Best Practices, p.4

Initial priority domains for Georgia have been selected on basis of one or more of the following criteria:

- Strong national science base (i.e. specialization patterns based on bibliometrics and/or patenting)
- High national economic relevance (i.e. high share in employment, high expert shares, strong economic growth, cluster development)
- Global challenges and/or priorities (e.g. climate change)

On basis of these criteria, the following six potential priority domains could be identified: Information and communication technology (ICT), Arts and Humanities/Cultural Heritage, Innovative Medicine, Food and Agriculture, Renewable Energy, and Circular Economy[13].

Focus groups were held in a mission in March 2022 to Georgia to identify relevant sub-priority domains for the interactive stakeholder dialogue in the workshop. From April 2022 to June 2022 online workshops were held with stakeholders from the quadruple helix[14] of the Georgian national innovation system. Inputs were collected in break-out sessions on digital pinboards. The results of these workshops have been transcribed and distributed to the invited stakeholders for feedback and further comments until mid of July 2022.

The final results of this consultation process are together with the workshop transcriptions synthesized in this report at hand.

[13] Analysis and discussions in the respective workshop showed for Circular Economy, that the issue is reflected strong gobal needs but is still premature in Georgia fort he identuification of prioritties for science policy

[14] Building on the triple helix model, the quadruple helix model adds a fourth component to the framework of interactions between university, industry and government: the public, consisting of civil society and the media. The framework aims to bridge the gaps between innovation and civil society, and it claims that under the triple helix model, the emerging technologies do not always match the demands and needs of society, thus limiting their potential impact. The framework consequently emphasizes a societal responsibility of universities, in addition to their role of educating and conducting research.

Synthesizing Overview

Thematic / Functional Priorities	***Information and Communication Technology***	***Arts & Humanities /Cultural Heritage***	***Food and Agriculture***	***Renewable Energy***	***Smart Health***	***Circular Economy***
Development of a national knowledge base	●	●	●	●	●	●
Development / Provision of Research Infrastructures	●			●	●	●
Provision of shared labs and testing /prototyping facilities		●			●	
Regulations and laws			●		●	●
IPR		●				
Adoption / Development of Standards	●				●	
Commercialisation / Internation-alisation	●	●	●		●	
Creation of public awareness				●		●
Creation of awareness among business	●				●	●
Development of national sector/technology strategy	●			●		

Information and Communication Technology

Background

Economic Relevance

There are longstanding challenges in the systemic collection and analysis of the data related to the ICT market and ICT companies in Georgia. The quantitative aggregated sector data concerning turnover and development trends are not gathered by Geostat separately from transport and communications. The only subsector where comprehensive historical and up-to-date data is available is telecommunications, regulated by the Georgian National Communications Commission (GNCC)[15].

Since the creation of GITA in 2014, there have been significant efforts to develop the digital ecosystem in Georgia. ICT-centric innovation development was one of the priorities of the Social-economic Development Strategy of Georgia, "Georgia, 2020". It fostered private sector competitiveness by improving access to finance and support in commercialization, developing the infrastructure necessary for innovation, and establishing an efficient communication network. To a large extent, it has laid the foundations of a vibrant ICT innovation ecosystem[16].

Currently, the ecosystem perceives a lack of competitiveness regionally and nationally. However, in the region, Georgia has a competitive advantage of using existing telecommunications infrastructure, including the submarine Black Sea Fiber-Optic Cable System to develop the corridor between Europe and the Middle East via Armenia and East Asia via Azerbaijan. This gives Georgia the potential to position itself as a safe and trusted data conductor and digital hub[17].

Cluster and Innovation

In the science sector currently, no specific specialisms for ICT can be observed for Georgia based on bibliometric and patenting analysis. But it should be noted that the particular strength in formal sciences (i.e. Mathematics and Physics) provide an excellent knowledge base for ICT research and innovation (see Annex).

The national innovation system for ICT is still in its nascent stage but several steps have been recently set to align the science and the enterprise sector: The Georgian ICT Cluster is a collaborative platform for ICT industry stakeholders that supports the establishment of business linkages locally and internationally to increase the competitiveness of the Georgian ICT industry and ultimately contribute to the economic development of the country. In November 2020, StrategEast Georgia has established the ICT Association of Georgia aiming to form a platform for discussing strategies and practical solutions for accelerated development of the ICT industry in Georgia. The first to join the newborn association were EPAM Systems, Alta Software, and the Bank of Georgia.

Accordingly, there is a growing need to identify priorities and research that reflect in particular the needs and existing competencies in the enterprise sector. Furthermore, ICT and digitization offer a window of opportunity to actively address challenges in society and with regard to other policy challenges such as climate change.

[15] USAID (2017), Innovation and Technology in Georgia, Annual Report

[16] ITU (2021), Country Review: Georgia

[17] Idem

Potential Functional Priorities

Priority Subfield	Functional Priorities

IT Services and interoperability	• Development of a national technological knowledge base:
	  ○ Education and Training of IT Specialists
	  ○ Upgrade of existing pieces of training at universities
	• Creation of awareness of IT issues (e.g. Cybersecurity) among companies
	• Positioning of Georgia as a location with a competitive advantage for outsourcing by international companies (i.e. Low wage rates/labor costs)

Cybersecurity	• Development of a national technological knowledge base:
	  ○ Education and Training of Cybersecurity Specialists
	  ○ Programming skills and advanced knowledge in mathematics (Students, with soldiers)
	• Integration of cybersecurity policies into standards and guidelines
	• Creation of awareness on cybersecurity among companies and promotion of effective training and cyber exercises
	• Fostering cooperation and networking activities for sharing the experience in Cybersecurity (e.g. with Ukraine and Lithuania)

Artificial Intelligence	• Strengthening partnerships between the universities and private organizations for AI teaching, research, and application • Certification of AI skills and training related to Natural Language Processing • Development of a national AI strategy • Provision of laboratory capacities for AI

Potential themes for collaborative science business projects

Priority Subfield	Themes
IT Services and interoperability	• Virtual museum: 3D models of artifacts, reconstruction. Multimedia and VR technologies in the visualization of artifacts. Virtual reconstruction of historical environment and built reality (Augmented Reality). • Complex environmental monitoring systems in the maintenance and protection of cultural heritage monuments • IOT (Internet of things): climate and environment based on technology-based monitoring systems; online data collection, automatic processing (Big data, facial recognition methods), and decision-making algorithms.
Integration of cybersecurity policies into standards and guidelines	• Security by design
Cybersecurity	• Programs minimizing the risk of economic damage due to malfunctions or manipulation of sensitive data • Security by design • Software solutions for critical infrastructures
Artificial Intelligence	• Natural Language Processing • Ethics related to the use of AI

Arts & Humanities/Cultural Heritage

Background

Economic Relevance

The cultural sector offers significant direct and indirect contributions to Georgia's national economy. A process of applying the UNESCO CDIS methodology in Georgia has revealed preliminary figures, demonstrating that in 2015, cultural employment corresponded to 5.02% of total employment. This figure is higher than EU standards[18].

In particular, the rich cultural heritage of Georgia forms one of the main assets for tourism[19]. In 2019, over 6 million guests from abroad were registered, a new record. The contribution of tourism to the gross domestic product is estimated at just under 10% of GDP. In 2020, however, arrivals dropped drastically to 1.1 million. Experts expect that the tourism figures from 2019 will probably not be reached again until 2022. During the past decade, Georgia's tourism industry has increased on average by more than 12.8% per year[20]. Between 2009 and 2016, tourism growth was one of the fastest globally[21].

In 2016, the government of Georgia launched the Culture Strategy 2025, a document setting priorities to make "Georgia a creative country and regional hub where innovation and creativity, along with safeguarding and revitalizing national heritage and cultural diversity are the fundamental pillars of social wellbeing and sustainable development." CCIs are recognized as a source of job creation, economic growth, and innovation. In addition, the technology sector is expanding in all the Eastern partner countries, including Georgia[22]. The year 2017 saw the establishment of LEPL Creative Georgia, a legal entity of public law within the Ministry of Education, Science, Culture, and Sport, whose mandate is to create a favorable environment for the development of creative industries through relevant policies, programs, projects, and grants[23].

Cluster and Innovation

In the science sector currently, a mild positive specialization for Art & Humanities can be observed for Georgia based on bibliometric analysis (see Annex). But it should be also noted that specialization patterns related to patents could be not analyzed as such a strategy to protect Intellectual Property Rights is not pursued in the sectors under scrutiny.

In 2016 the Georgian Culture Strategy 2025 was issued aiming to 'Develop Georgia as a creative country and regional hub where innovation and creativity, along with safeguarding and revitalizing national heritage and cultural diversity, are the fundamental pillars of social wellbeing and sustainable development'.

Several clusters and national platforms related to the cultural sector have been initiated in recent years in close cooperation with international donors and project partners.

[18] Farinha, C. (2017), Developing Cultural Industries in Georgia

[19] Piranashvili, M., Kadagidze, L. (2017), Georgia's Cultural Clusters as an Opportunity For Sustainable Development of Tourism

[20] TBC Capital (2019): Tourism industry overview: The next destination. Tbilisi, 2019.

[21] The World Bank (2018): Georgia: From Reformer to Performer. The World Bank. Washington, 2018.

[22] https://skillman.eu/creative-industries/

[23] https://en.unesco.org/creativity/news/euunesco-holds-three-day-workshop-designing-creative-cluster

The apparel and fashion sector in Georgia has been growing significantly in the years leading up to the Covid-19 outbreak. It has a strong export potential and in recent years, a buzz began circulating abroad about Georgian fashion designers. Dominated by high-quality niche creations, the products are labor-intensive and of a very high quality, which makes the sector ideal for a cluster approach. In 2020 the Georgian Apparel and Fashion Association (GAFA)[24] has been established, uniting local apparel factories, fashion designers, and ateliers[25]. GAFA has currently 25 members. Further clusters with close links to the cultural sector are the film cluster (established in 2017, 40 members), and the furniture cluster (established in 2017, 40 members)[26].

Potential Functional Priorities

1. Legislative support: Protection of Copyright and other IPR
2. Human resources: promotion of academic training; education at school
3. Provision of creative (multifunctional) spaces including technological infrastructure for prototyping (e.g. furniture)
4. Provision of a supporting framework for the internationalization of cultural products; supporting activities to anchor young artists internationally
5. Branding and storytelling concerning cultural heritage and products in the creative sector
6. Provision of managerial skills concerning cultural heritage and cultural products with a stronger emphasis on economics

Potential themes for collaborative science business projects

1. New research methodologies in cultural heritage (including IT)
2. Economic Studies on indirect benefits and/or the value of cultural heritage (monetarization)
3. Statistical data on culture, and economics of culture; Survey of creative industry/cultural heritage;
4. Digital instruments related to the Georgian language (e.g., spell checker)
5. Mapping of potential cultural heritage layers (GIS)
6. Digitization: Digital Storage and preservation; combining needs of cultural heritage and new digital methods (which digital tools and devices can support different cultural heritage)
7. Interdisciplinary projects combining science/technology with Arts & Humanities; Merge science and practitioners

[24] https://gafa.org.ge/en/

[25] GIZ (2020), Clusters4Development, Annual Report July 2020 – June 2021

[26] Vogler, B. 2021), Adjusting to changing FDI patterns –Leveraging clusters to tap new investment potentials, Policy Brief

Food and Agriculture

Background

Economic Relevance

For Georgia, agriculture remains an important sector in terms of GDP contribution. Agriculture accounted for 7-8 % of GDP for the last five years. The sector also provides an important safety net for the rural population, considering that over 40 % of Georgia's population lives in rural areas. According to the most recent agricultural census conducted in 2014, the share of commercial farms in agricultural production remained low. The overwhelming majority of households (93.6 %) own less than two hectares of agricultural land. Only 4.8 % of households own two to five hectares of land, and 1.5 % own more than five hectares. With such an ownership structure, commercial farming remains underdeveloped[27]. More than 40% of the workforce in Georgia continues to be employed in agriculture. Exports in this sector are developing positively (especially in wine, water, and agricultural products such as hazelnuts), but it will take greater efforts and reforms to make this sector truly competitive. Nevertheless, it was the only sector to finish positively with 3.5% growth in the crisis year 2020[28]. This share has fallen significantly over the past decades[29]. However, the dependence on agriculture is likely to continue into the medium-term future, and it is one of the greatest challenges to improve its productivity, increase farmers' incomes and reduce rural poverty[30].

Food and beverages accounted together 2021 for 26 % of all Georgian exports[31]. It is noteworthy that food products do not only dominate Georgian foreign trade in absolute numbers but also in relative terms. A recent analysis of trade patterns for Georgia shows a Revealed Comparative Advantage (RCA) for Food products (17.52) and vegetables (9.20)[32].

Clusters and Innovation

The Georgian Agriculture Development Strategy (2015 2020) focused on three interlinked challenges: ensuring food security through the improvement of productivity and incomes, adaptation to climate change, and promotion of climate change mitigation[33].

There is a high potential for the development of regional economic clusters in the domain of food and agriculture in Georgia. A recent study by UNIDO has identified several potential regional clusters in the

[27] US International Trade Administration (2022), Georgia - Country Commercial Guide

[28] WKO (2021), Aussenwirtschaft – Wirtschaftsbericht Georgien

[29] USAID (2017): Climate Risk in Georgia: Country Profile. https://www.climatelinks.org/resources/climate-risk-profile-georgia

[30] MoA (2017): Irrigation Strategy for Georgia 2017 – 2025. Ministry of Agriculture of Georgia. Tbilisi, 2017.

[31] German Trade and Invest (2021) Wirtschaftsdaten Kompakt

[32] Korganashvili, L. (2018), Georgia in the World Merchandise Trade: Main Trends and Problems of Development, European Journal of Economics and Business Studies, Vol 4 No 3

[33] Global Programme on Climate Resilient Economic Development (CRED) (2021), Georgia: Economy-wide Effects of Adaptation in Agriculture, Secoral Policy Brief

agrifood domain in the regions Kakheti, Kvemo Kartli, Mtskheta Mtianeti, Shida Kartli, Samtskhe-Javakheti, Guria, Imereti, and Samegrelo – Zemo Svaneti[34].

In 2021 the Georgian Seeds and Seedlings Association (GEOSSA) has been formed with EU and FAO support, in the framework of the EU4Business project "EU Innovative Action for Private Sector Competitiveness in Georgia" to boost the production of high-quality seeds and planting material and to comply with the upcoming certification system aligned to the international standards. In the next planned stage of development, GEOSSA shall become a cluster around the sector to bring together sector-involved actors and identify potential synergies and common initiatives[35].

Potential Functional Priorities

Priority Subfield	Functional Priorities

Research to support Food Quality and Safety	• Provision of safe and reliable testing and diagnostic laboratories operating across the country
	• Filling the gap in Legal and political regulations / to fulfill the European requirements on regulations (accreditation requirements)
	• Capacity development for entering the European market in Agriculture, Food Industry, Science, and Government
	  ○ knowledge of relevant regulations
	  ○ a national framework to meet regulations
	• Development of a national knowledge base for Food safety and quality
	  ○ Training and education of researchers
	  ○ Training of companies
	• Introduction of a Ph.D. program for food safety in Georgia

Future Farming and Agricultural Technologies	• Commercialization of new technologies – GITA programs are not focused on the introduction of new technologies • Training and education for young(er) farmers on new technologies • Promotion and demonstration of the benefits of new technologies (e.g. IT, irrigation systems, etc.) for farmers • Provision of a national framework and program for the testing of probiotics

Potential themes for collaborative science business projects

Priority Subfield	Themes
Research to support Food Quality and Safety	• Overall risk assessment and analysis for emerging risks in food safety and quality • Digitalization of agriculture systems, monitoring, and analysis of big data to identify challenges

[34] UNIDO (2019), Mapping Emerging and Potential Manufacturing and Agri-Business Clusters in Georgia

[35] Sakandelidze, A. (2021), Georgian Seeds and Seedlings Association GEOSSA

	• Building up monitoring programs (Residues, and research laboratories (for example ICP -MS, LC-MS/MS, GC-MS/MS….), and also in high-resolution screening equipment in research institutions (for example TSU) like HRMR, ICP_MS
Future Farming and Agricultural Technologies	• Biorefineries and Biofuels • Integrating artificial intelligence in agribusiness • Impact of climate change on soil and local climate • Reuse and treatment od waste in food production • Probiotics from plant materials

Renewable Energy

Background

Economic Relevance

The country's electricity sector has evolved from being based on a single-buyer model in the late 1990s – characterized by frequent blackouts, inefficiency, and non-payments – to an increasingly competitive model that incorporates private assets and enables greater system stability. Ongoing reforms aim to unbundle the electricity sector and enhance competition and security of supply in accordance with the EU energy acquis. Significant private investments have been obtained for the construction of new hydropower plants (HPPs), stimulated by Georgian power purchase agreements (PPAs) and attractive Turkish market prices for Georgian electricity exports.[36]

Georgia already has a considerably high share of renewable energy production (i.e. 82.6% of electricity generation in 2018)[37]. Thanks to the large share of hydropower in the country's energy mix, Georgia's CO2 intensity (fuel combustion emissions per unit of gross domestic product [GDP]) is below the world average[38].

Although Georgia's untapped renewable energy source (RES) potential has not been systematically measured, it is vast. Its approximately 300 rivers could produce a significant amount of hydropower, with potential hydro generation capacity estimated at 15 000 megawatts (MW), corresponding to an average annual production of 50 terawatt hours (TWh). Wind potential is estimated at 1 500 MW of capacity for 4 TWh of average annual electricity generation. In most regions of the country, annual sunshine duration ranges from 250 to 280 days (1 900 to 2 200 hours), indicating considerable solar photovoltaic (PV) and solar thermal potential.

As climate change is making it more challenging to generate renewable energy from water and biomass, its impact on hydropower production should be assessed and Georgia's reliance on hydropower could be reduced through the development of other RESs[39].

Cluster and Innovation

In the science sector, no positive specialization for energy research can be observed for Georgia based on bibliometric analysis. Specialization patterns related to Patents show positive specialization index values for Engines, pumps, and turbines (a technology field that is least partly related to energy production) (see Annex).

Implementation of Georgia's energy policy will require the deployment of new energy technologies and a commitment to continual improvements. While Georgia's R&D system has historically not been a major source of new and improved energy technologies, there is an opportunity for it to make up a greater portion of the technology value chain[40]. There is also a lack of connection between industry and local academic and

[36] IEA (2020), Country Report Georgia, p. 11

[37] IEA (2020), Country Report Georgia, p. 131

[38] Idem

[39] IEA (2020), Country Report Georgia, p. 143

[40] IEA (2020), Country Report Georgia, p. 152

research institutions. Most research-oriented projects are funded by international donors and involve international consultants, while SRNSF funding is allocated to academic disciplines rather than being used to solve the energy industry's cross-cutting intersectoral problems[41].

There have been also activities to cluster relevant actors in Georgia that are involved in the Renewable Energy Sector. The Georgian Renewable Energy Development Association – GREDA[42] was founded on the 4th of October, 2017. Our organization aims to develop and popularise renewable energy sources in Georgia and improve the investing medium. We care about elaborating fair regulations for the Georgian renewable energy market and raising social awareness about the subject. To implement the objectives mentioned earlier, GREDA actively cooperates with all stakeholders, including international organizations and the public sector. Georgian Renewable Energy Development Association combines 36 members.

Potential Functional Priorities

Priority Subfield	Functional Priorities
Research to support the development of Renewable Energy / Research Capacities and Infrastructure	• Capabilities and training: Need for courses for renewable energies, in-depth training both for researchers and professionals • Research infrastructures and Demonstrators for Renewables (e.g. solar, wind) • Creation of public awareness of the benefits of renewable energy
Green Hydrogen	• Development of a national hydrogen strategy in line with the EU strategy to align private and public views, and to ensure coherence with the other domains of energy policy • Development of a roadmap for green hydrogen in Georgia involving science, industry, and government • Public awareness raising on hydrogen and the use of these new technologies
Solar Energy	• Provision of a clear legal framework for investors • Capabilities and training: Need for courses for solar energy, in-depth training both for researchers and professionals

Potential themes for collaborative science business projects

Priority Subfield	Themes
Research to support the development of Renewable Energy / Research Capacities and Infrastructure	• Weather forecasts with high Geo resolution • Data on (local) energy demand and supply; Data on resources and potentials for renewables with high Geo resolution • Impact of climate change on the potential future yield of water power plants • Smart Grids and Microgrids

[41] Idem

[42] http://www.greda.ge

Green Hydrogen	• Assessment of the impact of developing the new technology on the labor market and the wider economy • Analysis of potential roles of ammonia in a green hydrogen world
Solar Energy	• Data on resources and potentials for solar energy with high Geo resolution Security by design • Impact of climate change on the potential future yield of solar energy power plants

Innovative Health Systems

Background

Economic Relevance

Over the last 13 years, Georgia's healthcare system has undergone effective reforms that have improved health indicators and narrowed the gap between Georgian and European standards. In 2013, the Georgian government introduced a universal healthcare (UHC) system for the entire population. The reform diminished the role of insurance companies as government funds flowed directly to healthcare providers. Renewed hospital infrastructure, combined with UHC, improved accessibility of care as well as patient satisfaction, with 96.4% of patients satisfied with UHC. Several rounds of healthcare reform, backed by strong political support, fostered a competitive environment in the healthcare sector by attracting private companies, which made considerable investments in the sector. Private sector spending, combined with the Health Ministry's (Ministry of Internally Displaced Persons from the Occupied Territories, Labour, Health and Social Affairs of Georgia) liberalization policy and increased government healthcare spending, creates room for sustained growth in Georgia's healthcare sector[43].

Georgia has considerable potential for medical tourism development and a perspective to become a hub of medical tourism in the Transcaucasia region. However, there is a number of significant barriers to overcome and challenges to respond to. This concerns the quality of medical care and the need for standardization of services and processes in medical facilities. Moreover, international accreditation and affiliation with international medical chains are suggested.[44]

The Life Sciences and Pharmaceutical sector accounted in Georgia 2019 for over 13,000 employees with 70 Manufacturers and 1,367 Pharmaceutical Products produced. It is also noteworthy that the export of Pharmaceutical Products grew with a CAGR of 21% from 2016 to 2019. Aversi Pharma, PSP Group, and GPC are three leading domestic pharmaceutical companies, controlling approximately 75% of the local market between them. These companies are engaged in drug distribution, as well as production and imports[45].

Cluster and Innovation

In the science sector currently, no positive specialization for Pharmaceutical and Medical Research can be observed for Georgia based on bibliometric analysis. But it should be noted that Pharmaceuticals show very strong specialization patterns in terms of patenting (see annex).

The sector is represented by producers of generics, antibiotics, and other relatively simple pharmaceutical products, on the one hand, represented by such large-scale companies as GMP, Aversi Rationale (the largest two players, producing almost 90 percent of local production), AbiPharm and BioFarm. On the other hand, there are herbal product producers such as NeoFarm, Innova, and Fanconi. Finally, companies are working in a new direction, phages, which are emerging as alternatives to antibiotics (for both humans as well as for

[43] https://2016.export.gov/industry/health/healthcareresourceguide/eg_main_116236.asp

[44] 1Mikava N., Vasadze O. (2020), GEORGIA'S PERSPECTIVES IN MEDICAL TOURISM- CHALLENGES, BARRIERS IN HEALTHCARE SECTOR, mineo

[45] https://finchannel.com/georgian-pharma-market-enjoys-rapid-growth/

animals), represented by several enterprises under the three companies: BioChimPharm (BCP), Biopharm-L and the Eliava Institute[46]. Also, a small cluster formed in recent years[47]

Potential Functional Priorities

Priority Subfield	Functional Priorities
Research to support the development of Innovative Health Systems	• Adoption of EU regulatory frameworks; e.g. EC Directive 10/63 (on the protection of animals used for scientific purposes), Regulation on biomedicine • Ensuring Quality of research: Evaluation criteria need to be harmonized (i.e., GE and International); quality/standards need to come to common terms to access international programs • Development of a national knowledge base: long-term development of capacities for education and training of young scientists • Funding of research infrastructure (i.e. laboratories and equipment) • Provision of shared laboratory spaces for companies • Make existing research capacities visible for business
Bacteriophages	• Industrial production of phages requires a clearer legal framework and clear and transparent research • Development of a national knowledge base: long-term development of capacities for education and training of young scientists • International standards – manufacturing practice is missing • Public support for the commercialization of research results
Herbal Medicine	• Establishing a regulatory framework to be able to access international markets; i.e. quality issues • Funding of research infrastructure (i.e. laboratories and equipment) • Promotion of new infrastructural investments for Herbal Medicine • Public support in the promotion of herbal medicine in local and international markets

[46] UNIDO (2019), Mapping Emerging and Potential Manufacturing and Agri-Business Clusters in Georgia, p.23

[47] http://pharmacluster.org/en

Potential themes for collaborative science business projects

Priority Subfield	Themes
Research to support the development of Innovative Health Systems	• Creation of new types of analgesic drugs
Bacteriophages	• Selection of specific phages for personalized treatment
Herbal Medicine	• Safety of herbal medicines and reliability of their use, their complexity to eliminate diseases • Studies about the effectiveness of specific herbal medicines • Mapping of space for cultivation and potential production capacities

Circular Economy

Background

Economic Relevance

Since 2015 – a year of the adoption of the Waste Management Code, Georgia has achieved significant progress toward an integrated solid waste management system. Regardless, there are several solid waste management challenges that the country struggles to overcome and is far from meeting the ambitious targets detailed in the National Solid Waste Management Strategy, which is harmonized with European Union standards[48].

At the national level, existing laws, regulations, and policies barely encourage service cost recovery, waste prevention, reuse, recycling and recovery, and private sector engagement. Certain critical regulations such as packaging with EPR, which is an efficient and effective mechanism for private sector engagement in waste recycling, are missing together with methodological guidance documents; there is no consensus reached between producers and local authorities on the most feasible EPR implementation modalities/schemes so far. Meanwhile, there is a need to build the knowledge and capacity of all relevant stakeholders, including GoG and businesses for the circular economy in general, and EPR in particular. Most importantly, there is no integrated solid waste information management system, with a central data depository and relevant databases that could support evidence-based decision-making and monitor performance management in the country[49].

Cluster and Innovation

In the science sector, no positive specialization for research can be observed for Georgia based on bibliometric analysis. Specialization patterns related to Patents show no positive specialization index values (see Annex).

Potential Functional Priorities

Priority Subfield	Functional Priorities
Research to support the development of the Circular Economy	• Development of research infrastructures • Development of academic training courses on circular economy • Development of a national monitoring and information system on waste streams
Circular Economy for Construction and Demolition Waste	• Development of research infrastructures • Awareness raising and capacity building among companies • Align to the European Legislation and best practice in the field • Implementation of Extended Producer Responsibility (EPR)

[48] The World Bank (2021), Georgia – Solid Waste, Sector Assessment Report, p.3

[49] The World Bank (2021), Georgia – Solid Waste, Sector Assessment Report, p.4

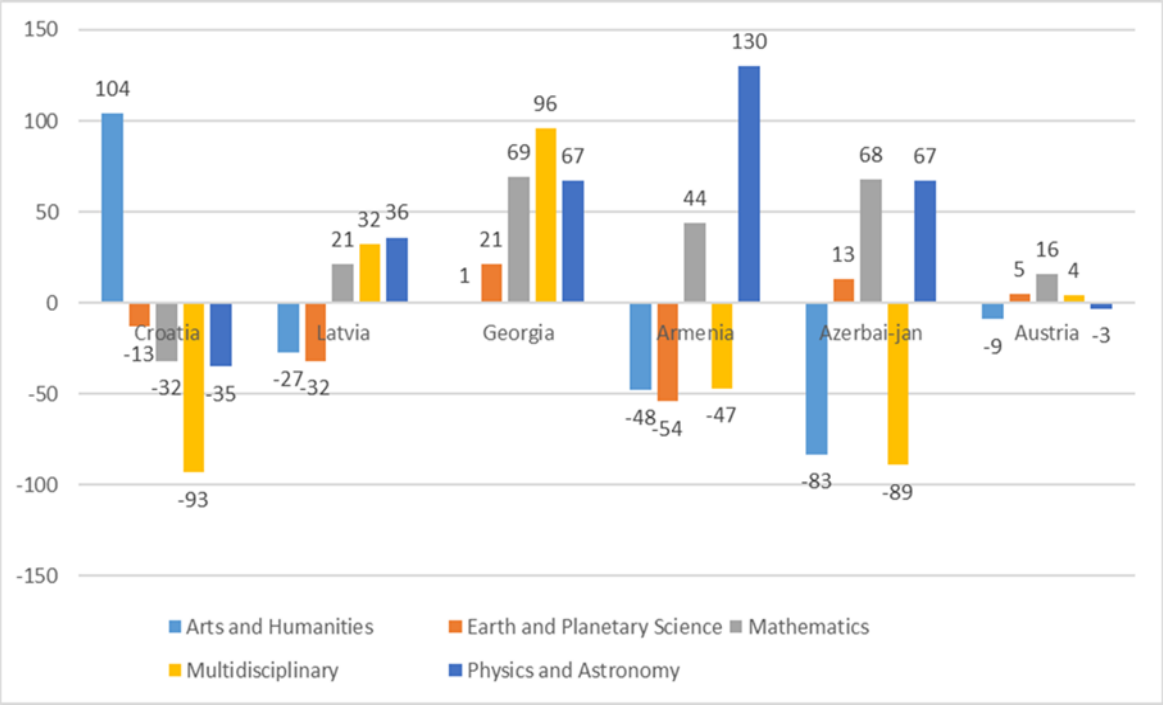
Potential themes for collaborative science business projects

Priority Subfield	Themes
Research to support the development of the Circular Economy	• Mapping of Circularity for different products in Georgia's Economy • Recycling of food waste
Circular Economy for Construction and Demolition Waste	• Research survey about waste management and demolition waste

Annex

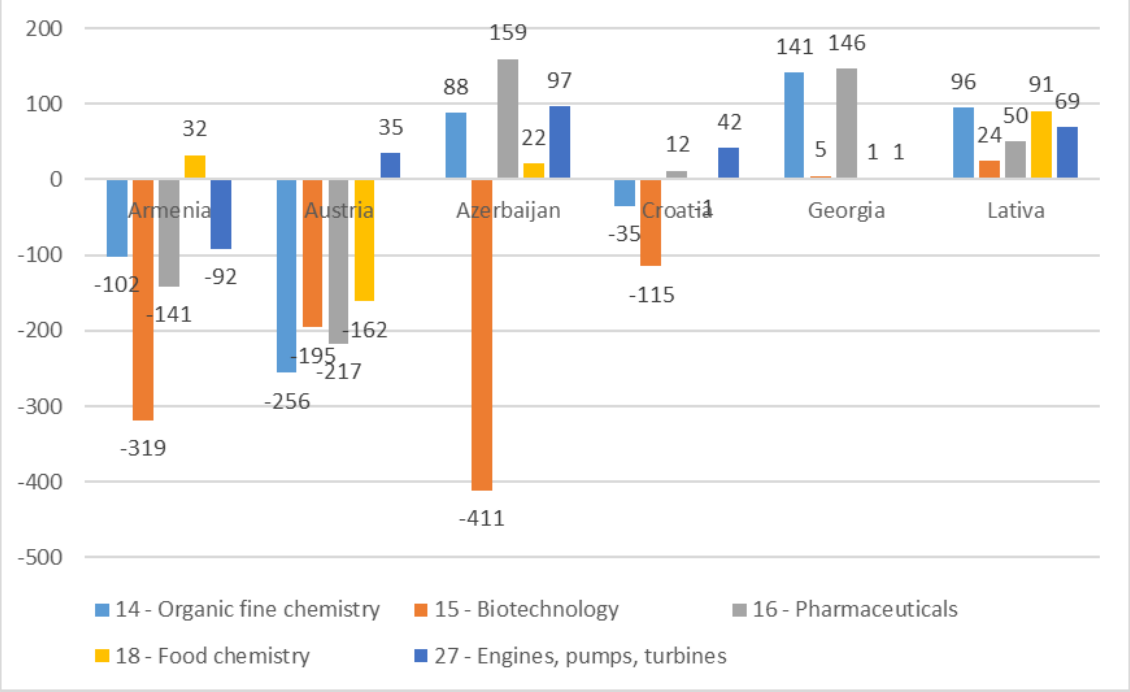
Scientific Specialisation Patterns for Georgia and Benchmarking Countries

Figure 2: Bibliometric Specialisation Patterns



Source: SCIMAGO, Own Calculations

Figure 3: Patenting Specialisation Patterns



Source: WIPO, Own Calculations