



Background Report

Peer Review of the Moldovan Research and Innovation system

Horizon 2020 Policy Support Facility



Research and
Innovation

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BACKGROUND REPORT

Peer Review of the Moldovan Research and Innovation system

Horizon 2020 Policy Support Facility

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1. EXECUTIVE SUMMARY

The purpose of the report is to summarise evidence on the situation in the field of science, technology and innovation (STI) in Moldova to provide a background for the Horizon 2020 Policy Support Facility Peer Review of Moldova's research and innovation system. This Peer Review, requested by the Academy of Sciences of Moldova, will be implemented by the panel of independent experts and national peers between November 2015 and May 2016.

Moldova, as a country having emerged of the former Soviet Union, has a tradition of education and research. In spite of the difficult social and economic situation since the independence of the country, a functioning education and a significantly downsized research system could be conserved. Tough cuts in education and research financing and very low investment in these sectors over many years have led to a decline in quality and outcomes. Still, some niches of excellence, for example in nanotechnologies, could be conserved.

The main legal basis for research and innovation policy in Moldova is the Code on science and innovation of 2004, and the annual partnership agreement between the Moldovan Academy of Sciences (ASM) and the government. Moldova's R&D and innovation system is rather centralised, with the ASM being the main policy-making institution fulfilling the role of a ministry of science. Besides ASM, several ministries deal with R&D and innovation related issues i.e. The Ministry of Economy, The Ministry of Environment, The Ministry of Health, The Ministry of Agriculture and Food Industry and The Ministry of Education).

At the operational level, the ASM is also the main policy implementation body. It is a research and innovation funding agency, it is the main research performing organisation in the country, and it takes also care of higher education in the frame of its own university. Nearly all public R&D and innovation funding programmes are managed by the ASM through its subordinated management bodies and agencies.

In Moldova the R&D funding is dominated by the government sector. The share of public R&D expenditure of total governmental expenses (1.6-1.8%) and of GDP (0.35%) is comparable to Eastern European countries, but due to the low GDP it is modest in absolute terms. The public R&D funds are allocated in three main modes: institutional projects, competitive funding, and other types of block funding (e.g. for libraries). Only research organisations accredited with the National Council for Accreditation and Attestation (CNAA) have access to governmental R&D funding in Moldova. Private companies and NGOs are not accredited, and are therefore not eligible for receiving funding through governmental R&D programmes.

Statistics on R&D funding by the business enterprise sector are not available for Moldova. Estimates are not encouraging and integration of the enterprise sector into the national innovation system is a difficult task. Modest investments of the business sector in R&D are determined largely by the structure of the economy where the low costs continue to be the main source of competitiveness.

The government sector dominates the performance of R&D; most of the resources (70.0% in 2011) are spent within the ASM and branch institutes of ministries. The Higher Education Sector has been gaining in importance in research performance and its share amounts to about 11% now. It is a policy priority of the country to strengthen research within universities. The business-enterprise sector performs 19% (figures for 2011, UIS 2015), but no clear picture of research performance in this sector is available.

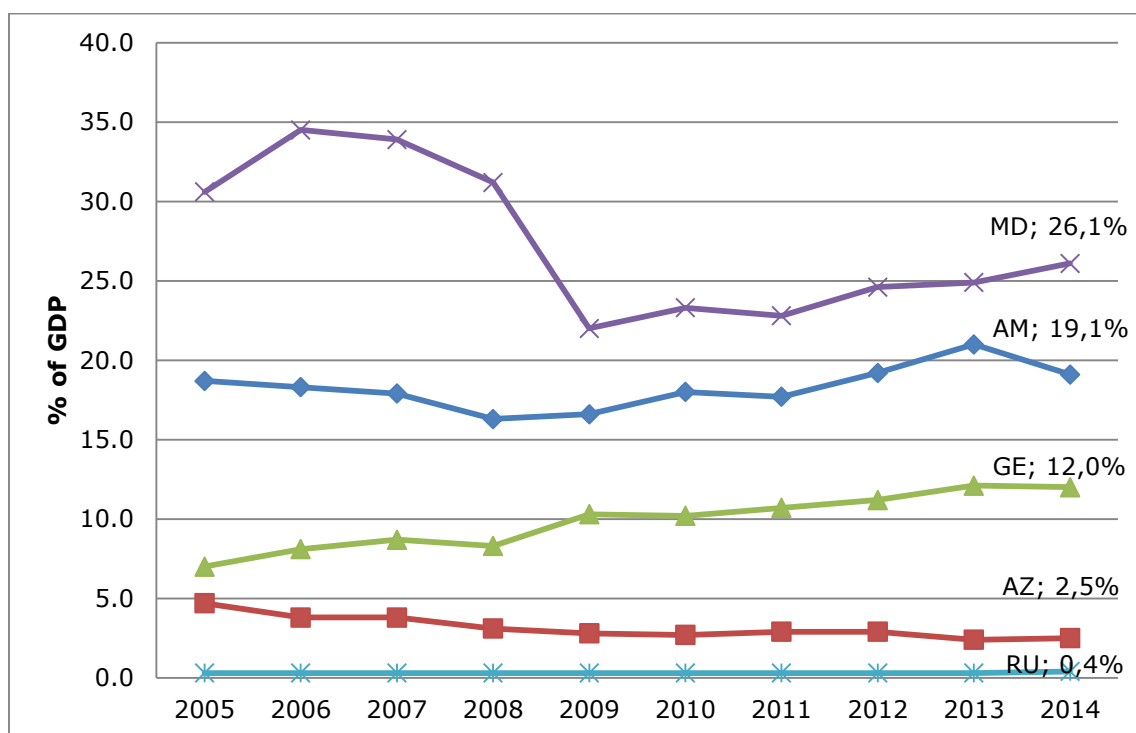
In the Republic of Moldova the R&D personnel has decreased drastically from 25,200 in 1990 to 5,038 (Head Count) in 2014. 3,315 were researchers (National Bureau of Statistics, 2015b). This strong decline was due to the very low financing of research and innovation over the last 25 years. It led to brain drain abroad and internally to other sectors of the economy. It is difficult to attract young talent to take up a research career or retain capable and young researchers in a research position. Recent national strategic documents foresee actions to address some of these challenges. Current framework conditions such as strained public budgets, limited number of innovative companies, low R&D expenditure of business, and migration of qualified personnel abroad are not very conducive to innovation activities.

Priority for Moldova's international scientific cooperation is the integration in the European Research Area. This is manifested both in multilateral and in bilateral cooperation. The Republic of Moldova, associated member of the FP7 and of Horizon 2020, occupies a leading position among the Eastern Partnership countries as regards the H2020 participation.

2. INTRODUCTION

The Republic of Moldova is a small country in Eastern Europe with a population of approximately 4 million. It is split into a main territory controlled by the Moldovan government and in the breakaway region Transnistria, which represents 12% of the territory and has a population of approximately 0.5 million. GDP growth has declined from a strong 9.4% in 2013 to 4.6% in 2014. For 2015 it is even expected to shrink by 2%. Moldova is the poorest European country in terms of GDP per capita, which reached only \$2,234 in 2014 (World Bank, 2015). The GDP is in absolute figures quite low and depends highly on remittances from Moldovans working abroad. Remittances arrived with 26.1% at more than a quarter of GDP in 2014, and were herewith higher than in other countries of the Former Soviet Union, such as Armenia or Georgia.

Figure 1 Remittances as a share of GDP for Moldova and other countries of the Former Soviet Union 2005-2014



Source: Authors
Data: World Bank, 2015

With about 30% of the labour force, Moldova's emigrant population is in relative terms among the largest in the world (Bouton et al., 2011). Corruption is an important problem for the country and has worsened in recent years.

Moldova, as a country having emerged of the former Soviet Union, has **a tradition of education and research**. In spite of the difficult social and economic situation since the independence of the country, a functioning education and a significantly downsized research system could be conserved. Tough cuts in education and research financing and very low investment in these sectors over many years have led to a decline in quality and outcomes. Still, some niches of excellence, for example in nanotechnologies, could be conserved.

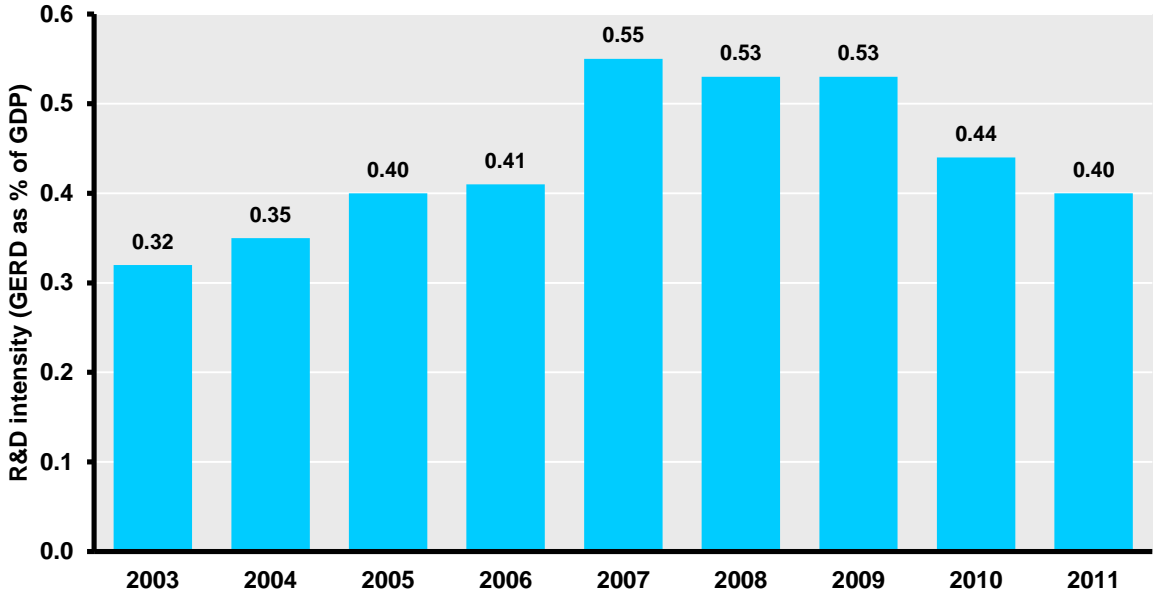
Since 2009 Moldova is governed by coalitions, which have set themselves the aim of European Integration. However, the **political situation** has become fairly unstable in the last years. After the last parliamentary elections in 2014, the three pro-European parties Democratic Party of Moldova (PDM), the Liberal Democratic Party of Moldova (PLDM) and the Liberal Party (LP), failed to agree on a coalition for a majority government. A minority government was formed, which was backed up by the Communist Party. On 30 July 2015, a new pro-European majority government was established, but which was dismissed already on 29 October 2015. The background of this instability is the famous banking scandal which drained the country of \$1billion (one eighth of the annual GDP), and the subsequent arrest of PLDM leader and former Prime Minister Vlad Filat on suspicion of fraud.

The Government Programme for the period 2015-2018 foresaw investments in education, science and information technologies as basis for development of a knowledge based society and economy. It provided for a reform of governance of scientific research, and of the development and technological innovation system. Furthermore, an open, inclusive and transparent organisational model, including a decentralisation of R&D funding and a strengthening of research in Higher Education Institutions (HEIs) was planned.

In 2014 major progress was achieved in Moldova’s rapprochement with the EU. Milestones include concluding the EU-Moldova Association Agreement and establishing a Deep and Comprehensive Free Trade Area (DCFTA). Visa free travel to the EU was agreed for Moldovan citizens, and the country got associated to the EU’s Horizon 2020 programme. It needs to be noted that Moldova was already associated to the EU’s FP7 programme, and was herewith the first associated country among the New Independent States of the Former Soviet Union. However, several critical issues need to be addressed to achieve Moldova's development priorities, and to deeper political association and economic integration with the EU. These issues concern improved governance, combating corruption, stronger public administration, an independent judiciary and strengthening the rule of law.

Gross Domestic Expenditure on R&D (GERD) as a share of GDP has been declining from 0.55% in 2007 to 0.4% in 2011 (UIS, 2015). According to data of the Moldovan Academy of Sciences (ASM) research expenditure from public sources and from abroad reached in 2014 an amount of Moldovan Lei 425.5 million (€23m), which was as a share of GDP a moderate 0.35% (SCSTD, 2015). In Transnistria approximately 21.2m Transnistrian Roubles (€1.4m) were spent in 2012 (last available year) by the local administration on R&D, which was equivalent to 0.49% of its budgetary expenditure.

Figure 2 Republic of Moldova - R&D intensity, 2003-2011



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
 Data: UNESCO UIS

3. GOVERNANCE OF THE R&I SYSTEM

3.1 Policy making

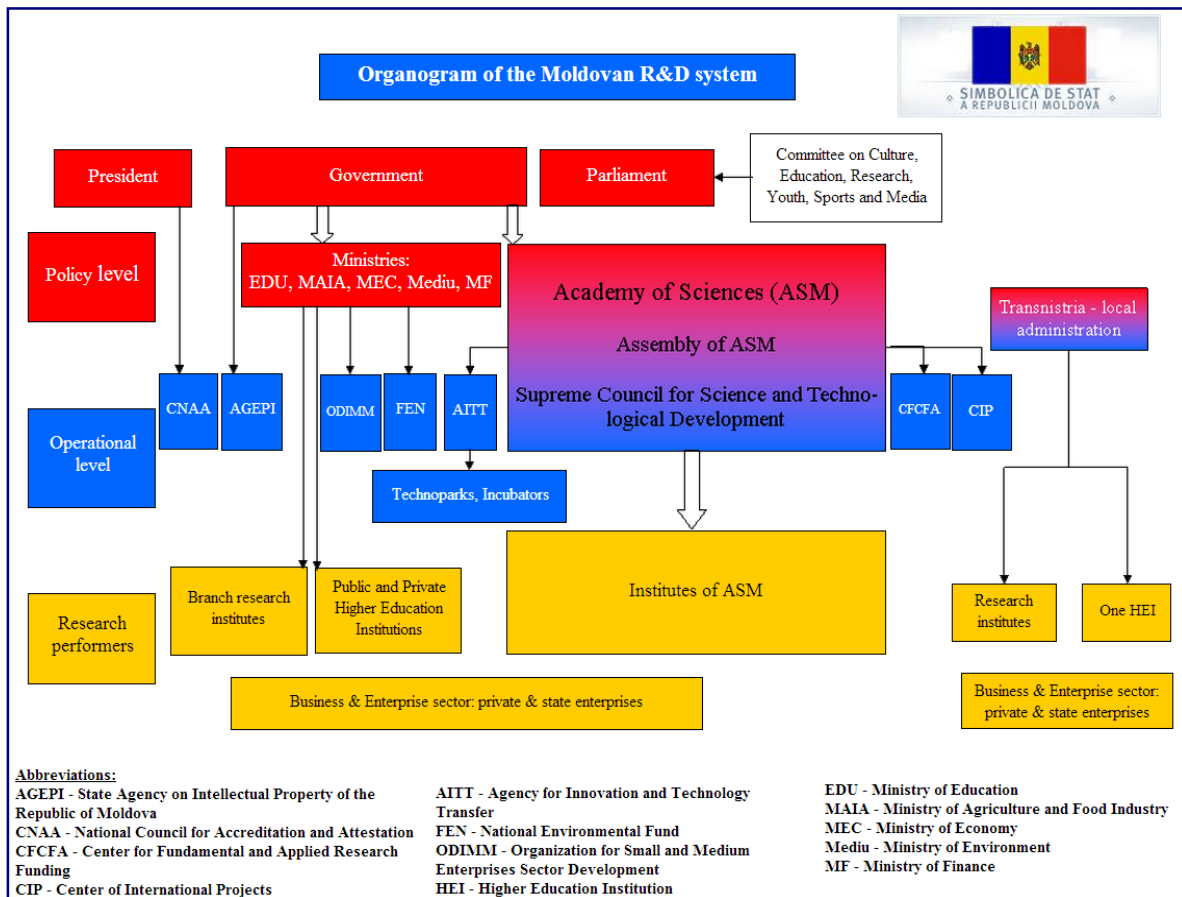
The main legal basis for research and innovation policy in Moldova is the **Code on science and innovation** of 2004, and the annual **partnership agreement between the Moldovan Academy of Sciences (ASM) and the government**. It needs to be mentioned at this point that Moldova's R&D and innovation system is rather centralised, with the **ASM¹ being the key player**. It is the main policy-making institution and fulfils the role of a ministry of science. The president of ASM is a member of the government. In the Partnership Agreement the rights and responsibilities of ASM are specified in detail, and include policy formulation, decision-making and coordination of the scientific and innovation activities, identification of the strategic directions in science and innovations, distribution of the budget allocations etc.

The **government** has delegated the competence to carry out the state policy in the field of science and innovation to ASM; it approves the Partnership Agreement with ASM and the R&D budget. The Moldovan Parliament adopts legal acts, approves strategic directions, and ratifies international agreements in the field of science and innovation. Within **parliament, the Committee on Culture, Education, Research, Youth, Sport and Mass-media** is responsible for the analysis and improvement of draft acts related to science and innovation.

Besides ASM, several ministries deal with R&D and innovation related issues. The **Ministry of Finance** has an important influence on the R&D sector through shaping the national budget, which includes the allocation of government resources for R&D. In addition, it sets the standards for the design, implementation and monitoring of funding programmes. It supervises the spending of public resources and the execution of the budget for science. The **Ministry of Economy** deals with R&D policy for ensuring economic competitiveness. Its tasks include policy-making for the implementation of R&D results, and for innovation and technology transfer in the business sector. An Innovation Strategy, approved in late 2013, resulted in a significant increase of the ministry's role. It is in a certain competitive position towards the ASM, and became the national coordinator of the implementation of innovation policy. The **Ministry of Environment** is, besides the academy, a governmental player managing own R&D funds. It allocates moderate R&D funding through its National Environmental Fund (FEN). The fund supports scientific projects in the field of environmental protection. The **Ministry of Agriculture and Food Industry** has a Directorate for Science, Training and Rural Extension, but in practice it has little influence on the implementation of R&D policy. The **Ministry of Health** disposes of several subordinated health research institutions. The **Ministry of Education** oversees the higher education sector and tries to strengthen the research capacities at the universities. Both the Ministries of Health and Education have been trying to establish own research funds, but have not come far yet with these efforts.

1 See http://www.asm.md/?new_language=1

Figure 3 Organogram of the Moldovan Research and Innovation System



Source: Own compilation by the authors

3.2 Policy implementation

At the operational level, the **ASM is also the main policy implementation body**. It is a research and innovation funding agency, it is the main research performing organisation in the country, and it takes also care of higher education in the frame of its own university. Nearly all public R&D and innovation funding programmes are managed by the ASM through its subordinated management bodies and agencies.

R&D policy is basically implemented through decisions of the **Supreme Council for Science and Technological Development (SCSTD)**, which is an executive body of the academy. The Supreme Council consists of 17 members, including the academy leadership and representatives of the scientific community. It coordinates the elaboration of R&D support programmes, and supervises its implementation and monitoring. A **Center for Fundamental and Applied Research Funding (CFCFA)** within ASM was established in 2012 for the allocation of public funding for fundamental and applied research. It manages the main Moldovan funding programmes: institutional projects, state R&D programmes, grants for young researchers, projects for the procurement of scientific equipment, for organising scientific events, and for editing monographs. The Center is not yet organised as an independent body, and it has seen frequent changes of leadership since it was established. It has though contributed significantly to transparency in R&D funding, as information about funded projects and SCSTD decisions on projects are published at its website.

The **Moldovan Agency for Innovation and Technology Transfer (AITT)** is a funding agency for support of innovation and technology transfer. It stimulates the cooperation of research institutions with business. The agency was established in 2004 and is also a subordinated agency to ASM. One of its main competitive funding tools is the annual call for Innovation and Technology Transfer Projects. Other funding tools managed by the agency concern support for technology transfer infrastructure (technoparks and incubators), and innovation prizes such as for business plans and technical innovations. Moreover the agency takes care of some promotional measures of innovations through a publicly accessible database and presentation of innovations at its website.

A **Centre for International Projects of ASM** was established in 2009. It promotes and administers bilateral grant programmes and international projects in R&D (including H2020 projects). A **Consultative Council for Expertise of ASM** deals with the evaluation of R&D and innovation projects submitted to the different competitions organised by ASM and its subordinated agencies.

The **National Council for Accreditation and Attestation (CNAA)** accredits research organisations in Moldova. This is quite relevant for institutions wanting to become eligible for public R&D funding; they have to undergo an evaluation and accreditation procedure, which is conducted by the CNAA. It is a governmental body and not part of the academy structure. Finally, other implementing agencies outside the ASM structure are the **State Agency on Intellectual Property of the Republic of Moldova (AGEPI)**, which takes care of protection of intellectual property, the National Environmental Fund (FEN) under the Ministry of Environment, and the **Organisation for SME sector development (ODIMM)**, which is the SME agency of the Ministry of Economy.

Local authorities have some rights in R&D policy, but there is **no specific regional approach** to the design or implementation of research policy and there are no special regional bodies for R&D development. There is a great difference in the R&D governance and activities between the capital Chisinau, which is inhabited by 21% of the country's population and generates approximately 50% of the GDP, and the rest of the country's territory. Among the 60 organisations accredited in the years 2005-2013 by the CNAA to carry out research and development activities, only three are situated outside Chisinau. The volume of R&D funding allocated to these three organisations in 2012 from the state budget amounted to 5.3% of total funding for institutional projects (basic funding for R&D organisations). The share of R&D personnel of these regional organisations of the overall Moldovan R&D personnel was 5.2% (ASM, 2015).

4. FINANCING OF R&D

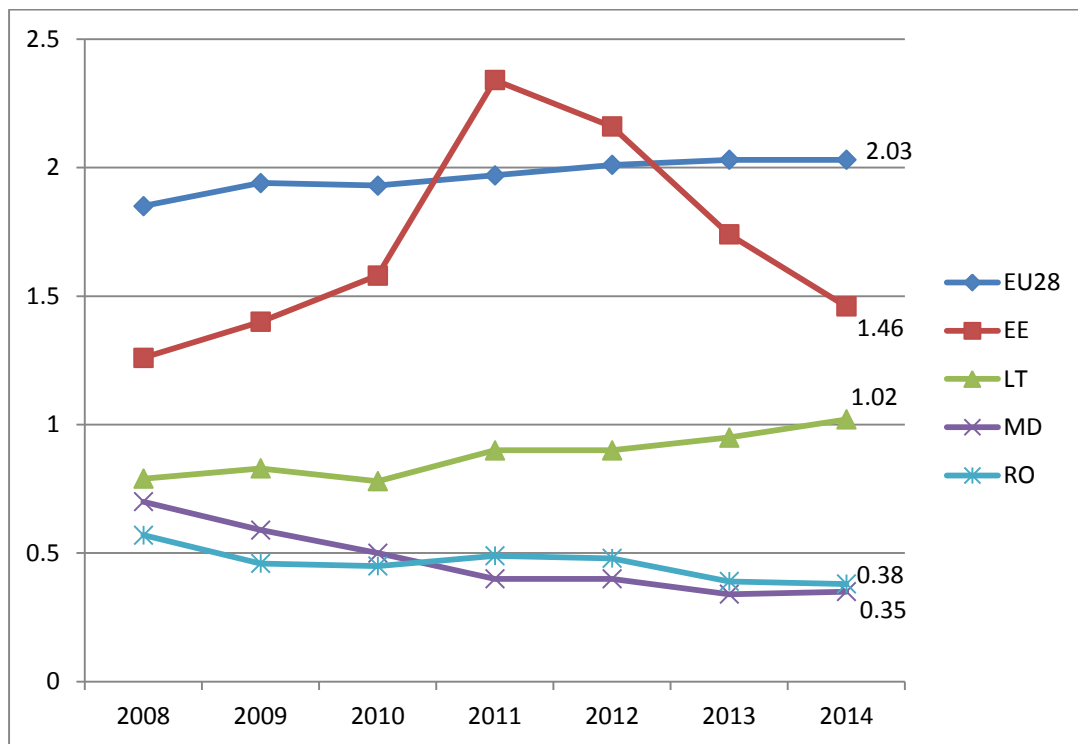
Investment into R&D is modest in Moldova. In Moldova's R&D Strategy approved in 2014, the general R&D investment target (for both public and private sectors) is fixed at 1% of GDP by 2020. Given the serious social problems the country is facing, financing of science and innovation de facto is not yet a national priority. The understanding of the importance of R&I as a basis for increasing of the competitiveness of the economy and for lowering the dependence of the country on remittances is still low in society.

GERD calculated according to data of ASM reached in the Republic of Moldova in 2014 an amount of Moldovan Lei 425.5 million (€23m), which was as a share of GDP a moderate 0.35% (SCSTD, 2015). GERD per capita (6.2 euro) is more than 80 times lower than the EU average. While GERD as a share of GDP has been declining or stagnating for many years, in absolute figures it has been increasing (by about MDL 70 million from 2012-2014).

In the analysis of figures, it needs to be considered that only fragmented data on R&D funding and on performance of R&D are available for Moldova. The ASM figures for GERD do not include R&D expenditure from general university funds and cover only a rather limited share of private R&D funding, as this is not yet recorded exactly in Moldova. Furthermore, official figures do not include R&D funding in Moldova's breakaway region Transnistria. In this region approximately €1.4m (21.2m Transnistrian Roubles) were spent in 2012 (last available year) by the local administration on R&D, which was equivalent to 0.49% of its budgetary expenditure.

R&D funding is dominated by the government sector. The share of public R&D expenditure of total governmental expenses (1.6-1.8%) and of GDP (0.35%) is comparable to Eastern European countries, but due to the low GDP it is modest in absolute terms. Figure 4 shows the development of GERD; the Moldovan share is approximately at the level of Romania; Baltic countries are well above these rates, with Lithuania experiencing a steady growth and reaching 1.02% of GDP and Estonia with a more fluctuating rate reached 1.46% in 2014. The average for the EU 28 has also been increasing steadily over the last years and arrived at 2.03% in 2014.

Figure 4 GERD as a share of GDP for EU 28, and selected countries 2008-2014



Source: Authors

Data: EUROSTAT, UNESCO UIS, ASM and SCSTD

4.1 Governmental R&D funding

The public R&D funds are allocated in three main modes:

- institutional projects
- competitive funding,
- other types of block funding (e.g. for libraries, experimental stations, administrative bodies such as SCSTD and CNA).

Only research organisations accredited with the National Council for Accreditation and Attestation (CNA) have access to governmental R&D funding in Moldova. Private companies and NGOs are not accredited, and are therefore not eligible for receiving funding through governmental R&D programmes.

The main public funding instrument is **Institutional Projects**. It is used for allocating basic funding to research institutions. Estimations based on data from ASM reports show that the share of public research funding allocated through this instrument increased from 67%, in 2010, to 75%, in 2014. The ASM administration decided, due to the declining public R&D funding, to cut the competitive and other schemes of funding in order to secure core funding of institutions. Under the current legal framework the institutional projects scheme is implemented on a semi-competitive basis, through calls for proposals and submission of projects proposals by the accredited institutions. Proposals are submitted to the Centre for Research Funding (CFCFA) and then evaluated by the Council for Expertise (CCE) according to generally applied criteria for funding programmes in Moldova. The SCSTD approves the funding of proposals. In practice this scheme is not competitive. Proposals do not compete with each other and the funding amounts are more or less pre-defined. The assessment and accreditation of institutions and their ranking by the CNA is not yet taken into account in the distribution of institutional funding.

Table 1 Overview of Institutional Projects

	2006	2007	2008	2009	2010	2011	2012	2013	2014
Institutional projects, million €	6.9	10.6	13.3	12.6	13	13	13.8	12.7	13.2
Share of governmental GERD, %	63.0	60.8	59.4	63.7	66.6	73.7	72.8	76.0	74.8

Source: Calculation by authors based on Annual Reports of ASM Exchange rate: 1 Euro = 16 Moldovan Lei (MDL) (until 2012); 1 Euro = 17 Moldovan Lei (2013); 1 Euro = 18,4 Moldovan Lei (2014)

The maximum duration of institutional projects is four years. The annual amount of funding is specified in the project contracts. Resources can be spent on costs of R&D personnel, the maintenance of facilities and on equipment.

Truly **competitive funding** through a project-based mode has been reduced in recent years from 16.3% in 2010 to 8.4% in 2014. The competitive funding schemes include state R&D programmes, grants for young researchers, grants for procurement of equipment, international projects, innovation and technology transfer projects (ITTPs), grants for training and PhD fellowships, grants for editing monographs and grants for organising scientific conferences. Evaluations are usually performed by national experts, whereas in only few exceptional cases international experts have been used. The reliance on national experts poses a problem to an objective selection of projects, because of the close relations of experts in a small scientific community.

Table 2: Main competitive funding schemes and amounts of funding allocated (million €):

<i>Scheme / programme</i>	2006	2007	2008	2009	2010	2011	2012	2013	2014
State programmes for R&D	0.68	1.25	1.11	1.10	0.61	0.36	0.34	0.08	0.20
Independent projects*²	0.08	0.13	0.27	0.28	0.32	0.31	0.38	0.18	0.16
International projects	-	0.33	0.41	0.52	0.48	0.42	0.28	0.36	0.35
Innovation and Technology Transfer Projects	0.19	0.52	0.72	0.75	0.86	0.69	0.62	0.45	0.54

Source: Calculation by authors based on Annual Reports of ASM Exchange rate: 1 Euro = 16 Moldovan Lei (MDL) (until 2012); 1 Euro = 17 Moldovan Lei (2013); 1 Euro = 18,4 Moldovan Lei (2014)

The main competitive R&D funding programme in Moldova, according to legislation, is the **State Programmes for Research and Development**. It is a mixed scheme, involving bottom-up and top-down definition of strategic priorities: general research themes for thematic sub-programmes within this funding scheme are proposed by the scientific community to the ASM. The government decides then, which topic shall form a thematic programme. The thematic programmes are approved for a four-year period with annual funding and reporting cycles. Calls for project proposals are therefore launched annually for each thematic programme, for which the four-year cycle has not ended yet. Since the start of the measure in 2004 and up to 2014, a total of €6.7m was allocated from the state budget.

Under the programme category **international projects** fall some bilateral joint R&D funding programmes with important partner countries for Moldova (Germany, Romania, Italy, France, Ukraine, Belarus and Russia). Governmental funding covers costs of Moldovan researchers, who participate in projects selected within these bilateral programmes. The budget allocated during the period 2007-2012 amounted to €3.2m. The bilateral programmes are de-facto bottom-up, as mostly broad research fields are defined for its calls allowing for proposals from a wide variety of disciplines.

2 Independent projects represent mainly the grants for young researchers (except for 2006 and 2011), the call for independent projects for 2011 includes 2 subprogrammes: grants for young researchers and grants for procurement of equipment.

Projects for **procurement of equipment** are granted since 2007. Purchased equipment is supposed to be used by several organisations. The amount allocated from the state budget for projects funded in this programme reached €2m in the period 2007-2014 (these data are calculated by the author on the basis of decisions on the allocation of funds, as this type of projects is not indicated separately in the budgets and official reports). Researchers can propose in a bottom-up approach equipment for purchase to the ASM.

Projects for young researchers are also granted since 2007. Governmental funding of around €1.7m was spent in this programme in the period 2007-2014. Calls for project proposals are launched annually. Selected projects may last up to a maximum of two years. The eligibility criteria require that at least four young researchers of up to 35 years participate in the project, including no less than 50% of graduate and doctoral students. A researcher with a scientific degree (at least PhD) of up to 35 years has to be the project manager. Projects have to be within the general S&T priorities. As these are rather broad, the programme follows mainly a bottom-up approach.

A competitive funding **scheme for organising international and national scientific events** is also available. In 2014 overall 24 scientific events were financed with an amount of €29,000. Another recent scheme provides **grants for editing monographs**. In the last two years (2013-2014) 24 projects were financed and a budget of €30,000 spent for it.

All these programmes were administered by the Supreme Council for Science and Technology Development (SCSTD). It organised the calls, took the funding decisions and monitored the projects selected. Since 2012 the Centre for Fundamental and Applied Research Funding (CFCFA) assumes these functions.

Innovation and Technology Transfer Projects try to link up research with implementing organisations, especially with businesses. The programme is administered by the Agency for Innovation and Technology Transfer (AITT). The agency organises the annual calls and monitors the projects selected for funding. The approach is bottom-up, because the thematic fields of this call are very broad. The total budget for 2007-2014 was around €5.4m. Selected projects are supported for a two-year period. The eligibility conditions require co-funding of at least 50% of the overall project cost from non-public sources.

Other types of public funding include block grants for administration, for facilities, for subordinated agencies to ASM and for infrastructures. In addition, on the basis of individual decisions of the SCSTD, funding is granted for publishing of books, for research on specific topics and other research related activities.

A well established R&D funding mechanism in Moldova is **excellence awards**. The following types of competitive awards are granted annually by the ASM (or at proposal of ASM):

- Scientist of the Republic of Moldova (€3,000) and Young Scientist of the Year (€1,250);
- ASM Award for scientific papers: 6 awards for senior scientists (€1,250 per award) and 6 awards for young scientists (€625 per award);
- Excellence Grants of the Government of Moldova and nominal scholarships for PhD students: 20 excellence grants (€160 per month) and 7 nominal scholarships (€125 per month).

The distribution of **public R&D funding on thematic priorities in 2014** (SCSTD, 2015) was the following:

- 1) Innovative materials, technologies and products – 36.3%;
- 2) Energy efficiency and use of renewable energy resources – 2.5%;
- 3) Health and biomedicine – 15.3%;
- 4) Biotechnology – 26.4%;
- 5) Cultural heritage and development of the society – 19.5%

In spite of these thematic priorities, most measures of R&D policy in the Republic of Moldova are generic ones and the procedures are identical for funding instruments, evaluation, monitoring, and reporting for all thematic priorities. Only the State Programmes for R&D are thematically focused. However, the topics in the programmes are kept rather broadly and the government funding allocated to this measure is modest. The financing of R&D programmes decreased in the past five years more than 3 times, reaching €0.2m in 2014 (SCSTD, 2015), which represents only 1.1% of public funding for R&D in Moldova. The distribution of public funds follows mostly a bottom-up approach, contributing to a weak integration of R&D into the innovation system.

4.2 Other funding sources

Statistics on R&D funding by the **business enterprise sector** are not available for Moldova. Estimates are not encouraging and integration of the enterprise sector into the national innovation system is a difficult task. The country ranks only 135th of 140 countries in the Global Competitiveness Report (GCR) for 2015-2016 on the indicator Company spending on R&D (WEF, 2013). Modest investments of the business sector in R&D are determined largely by the structure of the economy and by the distribution of the FDI stock in Moldova which are not encouraging for R&D performing activities. The industry is focused on trading and low-tech products. Low costs continue to be the main source of competitiveness. Innovation in the industry and in services is based mostly on foreign equipment and technology acquisitions instead of in-house technological solutions, since few Moldovan enterprises have any innovative departments. Data of the UNESCO Institute for Statistics show that in the last years the business enterprise sector performed between 10.3% (in 2010) and 19% (in 2011). In general R&D funding and performance of the business enterprise sector are quite moderate in comparison to EU countries.

An explicit national target for Business Expenditure for R&D (BERD) has not been fixed. But discussions are ongoing about increasing BERD, and different stakeholders are aware of this necessity.

Funding from abroad in general and European finances in particular are quite important for the Moldovan R&D system. The latest available data on funding from abroad as a share of GERD indicate 9.4% for the year 2011 (UNESCO), but this figure seems underestimated.

The following table gives an overview of international funding and projects supported in the period 2005-2010, on the basis of a report of the ASM Department of European Integration and International Relations for the government for the period 2005-2010.

Table 3: Funding from Abroad (2005-2010):

Name of programme / funder	Number of projects	million €
CRDF/MRDA	141	2.4
European Union	46	2.2
STCU	16	1.3
NATO SPS	6	0.9
SCOPES	25	1.3
International Atomic Energy Agency	4	2.0
Total	238	10.1

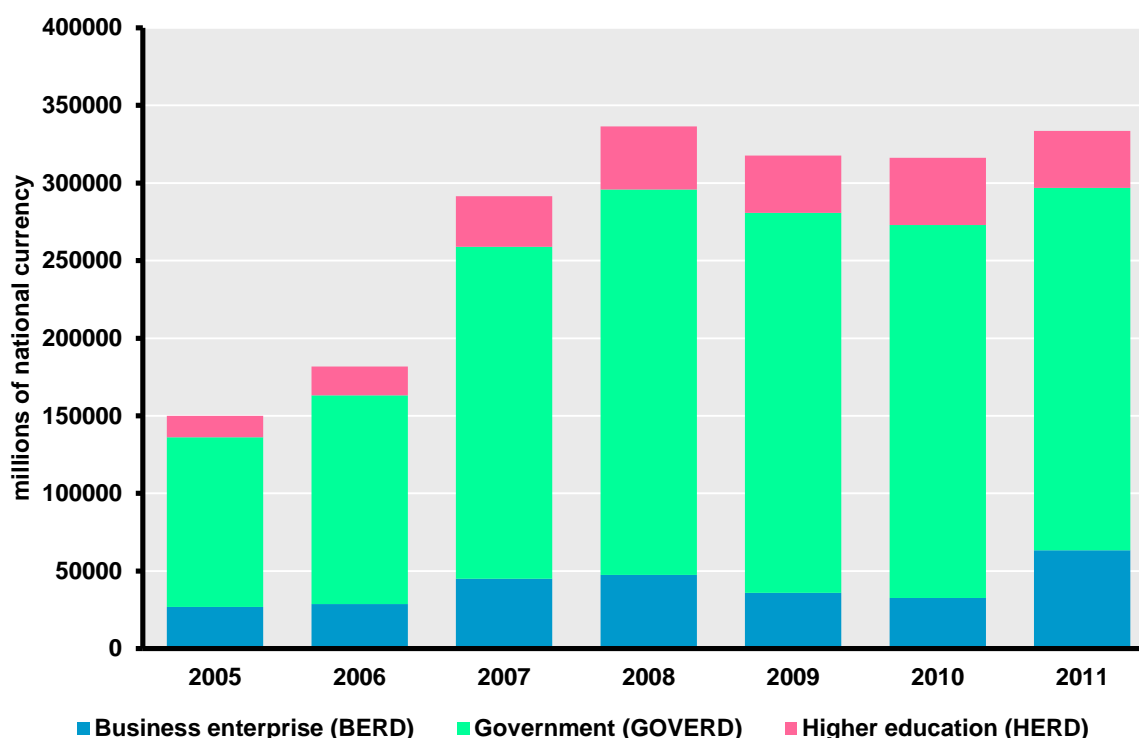
Source: ASM

R&D funding by the **private non-profit sector** is negligible to non-existent in Moldova. Exact data are not available, as this funding category is not yet covered by official statistics. Some local outfits of international foundations, for example the Soros Foundation-Moldova and the Moldovan Research and Development Association (MRDA), are organised as private non-profit organisations, but they are referred to under the category Funding from abroad and their importance has been declining over recent years.

5. RESEARCH PERFORMERS

The government sector dominates the performance of R&D; most of the resources (70.0% in 2011) are spent within the ASM and branch institutes of ministries. The Higher Education Sector has been gaining in importance in research performance and its share amounts to about 11% now. It is a policy priority of the country to strengthen research within universities. The business-enterprise sector performs 19% (figures for 2011, UIS 2015), but no clear picture of research performance in this sector is available. The private non-profit sector is insignificant in R&D performance. In Transnistria most R&D is performed in the governmental sector (more than 50%) and in its higher education institution (around 40%). Under the Code on Science and Innovation all research organisations accredited by the Council for Accreditation become members of the Academy of Sciences. They are categorised into three different types, in institutional, profile, and affiliated members of ASM.³ R&D organisations are evaluated regularly by the Council for Accreditation, and accreditation is granted then for a period of up to five years. In 2010-2014, most organisations have undergone their second evaluation and accreditation procedure, since accreditation was introduced in Moldova.

Figure 5 Republic of Moldova - GERD by sector of performance (in millions of national currency), 2005-2011



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
Data: UNESCO

5.1 Public research organisations

The Moldovan R&D system is dominated by Public Research Organisations (PROs). Research capacities are concentrated especially in the Moldovan Academy of Sciences (ASM) and its subordinated research institutes. Over 80% of R&D funding from the state budget is allocated to public research organisations. The highest share of R&D activities is conducted in applied areas. Most public R&D institutes belong to the scientific field of natural and life sciences. Researchers from public R&D institutes get the vast majority of patents and are publishing more articles in journals listed in the Web of Science than representatives of the higher education and business enterprise sectors.

Data of the National Bureau of Statistics show that in 2014 R&D activities were conducted in **51 public R&D organisations**. Among these PROs are the following categories:

3 See <http://www.cnaa.acad.md/accreditation-commission/>

- **Institutes of the Academy of Sciences** (institutional members of ASM), which report administratively and scientifically to ASM: 19 academy institutes are accredited by the CNAA;
- **R&D institutes subordinated administratively to different ministries** (former branch R&D institutes). This category covers 15 organisations accredited as “profile members” of the ASM, including eight of them subordinated to the Ministry of Health and five to Ministry of Agriculture. They are scientifically supervised by ASM and receive public funding also from the academy.
- Furthermore there are several organisations in the category of public **design-investigation organisations and design offices for construction works**.

The strongest research institutes with an established international scientific record in their research area are the Institute of Applied Physics and the Institute of Chemistry of the academy. An important research branch in Moldova is agriculture and several institutes are active in this field. An example of a PRO in agriculture with a significant share of economic activities is the Institute of Crop Production “Porumbeni”. It has created several corn hybrids on a contract basis for their partners in post-soviet countries; e.g. its hybrids account for 80% of the Belarusian market.

In Transnistria four more public research organisations are located. They are dealing mostly with agricultural and environmental related R&D, but have rather limited capacities. These organisations are subordinated to the departments of the local administration, which are responsible for agricultural and environmental matters.

5.2 Higher Education Institutions

The National Higher Education System includes **31 institutions, of which 19 state and 12 private universities**. The number of enrolled students decreased constantly since 2006. There are two main reasons for this development: in 2006 the government introduced enrolment rates for all universities, and demography. In the academic year 2014/15 89,500 Moldovan and 2.500 foreign students were enrolled. There were 252 students per 10,000 inhabitants (National Bureau of Statistics, 2015a). A significant trend is a strong orientation to social sciences, while a lack of students and graduates in ICT, sciences and engineering can be observed. The teaching staff of universities amounted to around 5,400 persons (2014/15). The mission of the universities is primarily focused on education, while research activities and related links to business are weakly developed. Theoretically, all university teachers must carry out R&D, but usually the staff is overwhelmed with teaching duties and only a few conduct substantial research. Even so, the university sector contributes about one third of Moldovan researchers, who have published in journals included in ISI and about two fifths of patent applications filed.

20 universities have been accredited as R&D performing institutions, including 14 state universities as so-called “profile members”, five private ones as “affiliated members” and the University of ASM as “institutional member”. According to calculations based on the ASM Annual Report for 2011, 12 universities were allocated an amount of €1.8m for R&D institutional projects from the state budget. This was equal to around 13% of public funds for R&D institutional projects. Total R&D funding in the higher education sector is higher, as allocations from general university funds (GUF) and other sources need to be considered. However, these figures are not available.

In Transnistria the situation is somewhat different with research concentrated in its Shevchenko university.

5.3 Business enterprise sector

The last data of the National Bureau of Statistics on research performers by sectors (2009) mention **eight private R&D organisations**, four mixed (public and private) R&D organisations and one joint venture organisation. But **these figures are far from complete**, because the Bureau of Statistics does not yet systematically collect data on research performing organisations in the business enterprise as well as private non-profit sectors. Therefore data are neither available on the R&D expenditure of these sectors, nor on the top private R&D spenders.

At the time of the dissolution of the Soviet Union at the beginning of the 1990s, the R&D sector in general and also R&D in state enterprises was relatively well developed. This situation changed dramatically with the independence of Moldova. Companies got disconnected from their former research partners and markets, and R&D funding from public resources declined drastically. Most of the industrial R&D potential was lost during the transition years up to now. A few companies tried to preserve their potential in cooperation with foreign partners. This concerns for example the Topaz plant, which was bought by the Russian state company “Salut”. Other companies, such as the “Sigma” plant, had to reduce significantly R&D or shifted completely to non R&D related activities.

Today the **majority of enterprises in Moldova carry out only minor R&D activities**. Those companies performing some R&D fund it predominantly from own resources, and they are primarily focused on the implementation of developments. Most of these companies are located in the capital Chisinau. Four state enterprises, the Institute of Agricultural Engineering "Mecagro", the Research and Production Enterprise of Aquatic Biological Resources „Aquaculture-Moldova", the Research Institute for Construction "INCERCOM", and the Institute for Development of Information Society are among the accredited R&D institutions (so-called "profile members" of the Academy of Sciences).

For Transnistria it is still more difficult to get a picture on R&D in the business enterprise sector. The spirits and wine producer KVINT in Tiraspol performs some R&D and one more private R&D institute exists.

6. HUMAN RESOURCES

In the Republic of Moldova the **R&D personnel has decreased drastically from 25,200 in 1990 to 5,038 (Head Count) in 2014**. 3,315 were researchers (National Bureau of Statistics, 2015b). This strong decline was due to the very low financing of research and innovation over the last 25 years. It led to brain drain abroad and internally to other sectors of the economy. Most of the R&D personnel are employed in the governmental sector. The number of researchers per 1 million people is more than 4.5 times lower than in EU. This gap is likely to widen, given the trends of emigration of talented young researchers and low attractiveness of scientific careers. The data are however underestimated, because official statistics do not consider R&D personnel in the private enterprise sector and universities researchers which are not financed from governmental R&D funds. As to UNESCO data there were 2.25 researchers per thousand labour force and 2.41 researchers per thousand total employments (in FTE) in 2011, which is much less than in most EU countries (UIS, 2015). In addition, the human resources of Transnistria have to be considered, which amounted to 504 R&D personnel in 2012, including 387 researchers.

For the existing researcher stock a certain **ageing trend** can be observed: average age of the researchers reached 49.1 years (SCSTD, 2015) and the share of young researchers is below 25% (National Bureau of Statistics, 2015b). The share of the population with tertiary education is relatively high, but new doctorate graduates per 1000 people aged 25-34 is more than 5 times below the EU average. According to the GCR for 2015-2016 on the indicator "Availability of scientists and engineers" the country is ranked on the 132nd position of 140 countries (WEF, 2015).

Moldova has experienced also large-scale emigration of other skilled workers. Moreover, there is a **mismatch between the education provided and the needs of the real economy**. The educational approach in HEIs is still rather traditional and not sufficiently targeted at the needs of the private sector. A relatively large number of graduates entering the labour market claim that they need additional training in order to meet the job requirements. In the period 2005-2010 less than ¼ of university graduates were employed within one year (Ciurea et al., 2012). Creativity, critical thinking and other features of modern education are not yet sufficiently high on the agenda. Innovation entrepreneurship training is becoming more relevant, but not widely available. Student preferences have changed from natural to social sciences. As a result, finding workers with the relevant level of skills is a difficult task for employers. This lack of skills has a strong impact on the innovation potential of firms. The share of employees in technology-intensive sectors is very low. Life-long learning is nearly absent: less than 1% of employees participate in any form of training (PRO INNO Europe, 2011).

6.1 Attracting young talent

It is **difficult to attract young talent to take up a research career** or retain capable and young researchers in a research position. Aside from the general economic situation of the country, this is due to financial and structural conditions for students and lecturers at universities and research institutions. As salaries are low, it is a common practice that professors increase their teaching hours significantly by lecturing at other universities. Also stipends for PhD students are low (about €60 per month), and this obliges them to work in parallel to their studies. Talented young people who left abroad usually do not return.

In 2014 the number of **PhD students** was 1628; in addition, around 264 foreign PhD students were enrolled (National Bureau of Statistics, 2015c). Moldova is one of the few European countries where the number of PhD students decreased in the period 2004-2010. The number of PhD students per 1 million inhabitants is 4 times less than in Estonia and over 7 times less than Finland. The number of scientific degrees awarded annually in the period 2004-2014, reached 50-60 per 1 million inhabitants (CNAA, 2015), and is herewith below the majority of European countries which register 150-300 degrees (EUROSTAT, 2015). The share of students and PhD students in sciences

and engineering (S&E) is significantly lower than previously and below the EU average. While in 1990 every second researcher was engaged in technical sciences, in 2014 it was only every fifth. Most PhD degrees in 1996-2014 were awarded in law, economics, education and medical sciences (almost 60%), while much less degrees were awarded in natural sciences or engineering. Several fields lack therefore qualified researchers.

Recent national **strategic documents foresee actions** to address some of these challenges. One of the five objectives set by the Innovation Strategy aims at enhancing the innovation skills of the population. Training programmes and new courses will focus on innovation development, and more students will be stimulated to take up studies in science and engineering. The Strategy Education-2020 foresees modifications in the university curricula to focus stronger on skills and the needs of the economy and society. Important reforms were undertaken in the Higher Education Sector in 2012-2014: the doctorate as 3rd cycle of Higher Education was introduced, a roadmap for vocational education prepared, financial autonomy of Higher Education institutions introduced, and an agency for evaluation in education established.

Specific instruments are used for involving students in research and keeping young researchers in science: quotas for young researchers in projects supported under public R&D funding programmes (at least 20-30% of researchers); an annual specific competitive support programme for young researchers of up to 35 years; excellence grants of the Moldovan Government for PhD students; establishing educational institutions within ASM (the Lyceum for gifted children and the University of the ASM). In 2012 the Moldovan Government adopted a decision for harmonising salary levels of researchers, who participate in EU and international R&D projects. This decision is in accordance with the FP7 Guide on Financial Issues. It allows for calculating higher person month rates than the usual national Moldovan rates.

6.2 Employment and working conditions

The **employment and working environment for researchers is not attractive**. Cuts in public R&D funding, an unstable economic situation and limited career opportunities have a negative impact on researchers. The average monthly salary of a researcher in a public research organisation was only €240 in 2014 (SCSTD, 2015). Salaries in several sectors of the economy are much higher than these average levels, and the level of remuneration is hence one of the main factors which discourages talents to stay in research. Research and education organisations usually have a high degree of flexibility in setting the level of salaries for their academic staff. Individual income can vary significantly depending on the research projects, in which researchers are involved. This makes international cooperation projects with usually higher labour cost levels particularly interesting. Research traineeships in companies and intersectoral mobility programmes are not yet available in Moldova.

With the current salary rates and infrastructure situation, Moldova is not a destination for inward mobility, although scientific positions are open also for foreign citizens and stateless persons. The labour market is in practice protected because non-nationals can only be hired if the position cannot be filled within 15 days with a local citizen. In the Global Competitiveness Report 2015-2016 the country capacity to retain talent and to attract talent the country has been ranked 137th and 138th respectively, among a sample of 140 countries (WEF, 2015).

Transparency of recruitment procedures is limited. The announcements contain little information about job vacancies and usually do not include requirements for positions, selection criteria or the composition of the selection panel. In most cases the job competitions and appointments for a period of 4 years are only a formality, as the positions are filled with staff already employed at the institution. Moldovan researchers do not often change their position and portability of grants is in practice rather difficult or not feasible. These issues and a lack of foreign researchers indicate a low level of openness of the national recruitment system.

Several **efforts are being made for moving closer to European standards**. ASM accepted the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (Charter & Code). In 2013 the national EURAXESS portal was launched, and 3 Moldovan institutions are meanwhile among the Human Resources Strategy for Researchers (HRS4R) Acknowledged Institutions (Moldova State University, National Institute for Economic Research and University of Academy of Sciences).

Gender equality: women and men have equal rights in education and in getting positions in the academic and other R&D institutions. While the proportion of women in tertiary education is higher than that of men, it is lower at the PhD level and in academic positions. In particular, the share of women in top-level positions and in decision-making bodies is well below that of men. For example in the Assembly of ASM, which is the supreme governing body of science in Moldova, women make up only 7%. One of the main reasons is a traditional attitude towards the role of women in society

and the family, where leading positions are filled mostly with male colleagues. Another reason is infrastructure, marked by a lack of child-care facilities. In science a horizontal segregation can be observed, with a net predominance of women in the social sciences and an under-representation in technical sciences.

7. INTERNATIONAL R&D COOPERATION AND MOBILITY

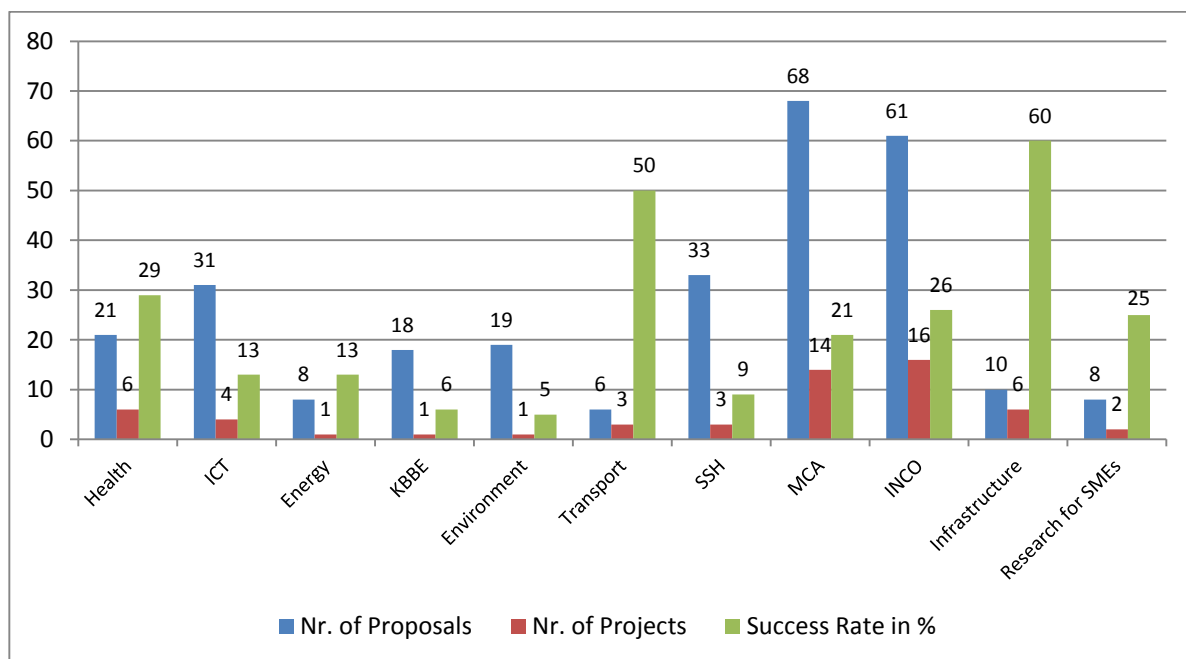
International R&D cooperation is a success story of Moldovan S&T policy-making. Bilateral R&D cooperation and mobility programmes, and the association to FP7 and H2020 are the flagship initiatives in this field. International R&D cooperation was highly important for Moldova since its independence and helped increase financial resources for leading teams, allowed building linkages with foreign researchers and access to modern infrastructure. National funding allocated to international R&D amounts to about 2.5% of public R&D funds.

7.1 Integration in the European Research Area

Priority for Moldova's international scientific cooperation is the **integration in the European Research Area**. This is manifested both in multilateral and in bilateral cooperation. The Republic of Moldova became an associated member of the FP7 with 1 January 2012 and of Horizon 2020 with 1 January 2014. To make the association a success, several measures were taken: Action Plans on the implementation of the associated status were drafted, and a network of National Contact Points and of regional information points (in Comrat, Cahul, and Balti) established. Presence was shown in Brussels with the Moldovan Office for Science and Technology (MOST). A Catalogue of research groups from Moldova and awareness raising on the European programmes among the local scientific community were important too.

In **FP7**, Moldovan teams were involved in 337 project proposals. Out of these proposals 58 were accepted for funding, and €4.15m allocated to Moldovan teams (Center for International Projects, 2015).

Figure 6: Participation of Moldova in FP7



Source: Center for International Projects (CIP) of ASM, 2015

Moldova is involved in EU funded international networking projects for the region – the INCO-NETs for the Eastern Partnership countries and for the Danube Region (INCO-NET EaP and Danube-INCO.Net) and in European Research Area Networks - ERA-NETs, the regional Black Sea ERA.Net and the ERA.Net RUS Plus. The partner from Moldova is the Academy of Sciences, which participated with a funding contribution in joint calls for R&D projects of these ERA-NETs. Moldova participates in actions supported under the European **COST** programme. The COST annual report 2013 indicates four running actions with participation of the Republic of Moldova. Moldovan institutions are not yet involved in the **EUREKA** programme. Moldova participates in three initiatives of the first **European Innovation Partnership (EIP)** – on Active and Healthy Ageing (Patent medication adherence programmes; Knowing effects on healthy life years; and Innovative

medical technologies for active and healthy aging). Given the specialisation of Moldova a participation in the EIP on Agricultural Sustainability and Productivity would be interesting. The Republic of Moldova also participates in two **Joint Programming Initiatives**: Cultural Heritage and Global Change: A New Challenge for Europe, and Water Challenges for a Changing World.

Moldova is involved in several multilateral cooperation schemes in the post-Soviet space. A relevant forum for R&D cooperation is the **Science and Technology Centre in Ukraine (STCU)**. This international organisation operates with resources provided by the EU (via Europeaid), the USA and other international partners and supports R&D projects in Ukraine, Moldova and other countries of the former Soviet Union. Since 2006 Moldovan organisations have received 32 grants from the STCU totalling more than €2m. Moldova launches joint calls with the STCU, which are co-financed by the partners. In the period 2012-2013 the partners have jointly funded 11 projects. The projects were supported in the following fields: nanotechnologies and new materials (4 projects), energy (4), and in agriculture and biotechnology (3). Another important multilateral cooperation is performed by the Moldovan researchers in the framework of the major infrastructure Joint Institute for Nuclear Research (Russia).

At the level of **transnational regional cooperation**, Moldova participated in the **EU regional support programme** South-East Europe. As a result Moldovan teams were involved in 17 projects. Two more EU cross-border cooperation programmes were relevant for Moldova: the Romania-Ukraine-Republic of Moldova Cross Border Cooperation and the Black Sea Cross Border Cooperation. The EU funding for the RO-UA-MD CBC Programme amounted to €126.7m for the period 2007 to 2013 and for the Black Sea CBC to €28.1m for the same period. Priorities in these programmes focused on economic development, environment, culture and education, and people-to-people contacts. Support for R&D and especially innovation activities among companies are included in these priorities.

Another regional cooperation relevant for Moldova is the EU inspired macro-regional cooperation for the Danube region. The EU Strategy for the Danube Region was endorsed by the EU General Affairs Council in April 2011. Financial resources available under the structural and cohesion funds are used to a greater effect for the implementation of the strategy. An action plan for the strategy includes as one of four pillars "Building prosperity in the Danube Region (e.g. developing research capacity, education and information technologies, supporting the competitiveness of enterprises and investing in people's skills)". Moldova coordinates together with Austria the priority "To invest in people and skills". The EU interreg **Danube Transnational Cooperation Programme 2014-2020** is an important regional funding tool in this context. It has already implemented a call for projects with closure on 3 November 2015. Participants from Moldova cannot be funded yet in this first round of calls, but this will be possible in the future.

Another international (non-EU) programme relevant for R&D funding in Moldova is the **NATO Science for Peace and Security Programme**. Various projects and workshops were supported by NATO in the fields of geology, agriculture, energy, environment, ICT. Joint NATO and EU funding have contributed to improving the internet access for research and education institutions through connecting it to the pan-European network GEANT.

7.2 Bilateral R&D cooperation

At the **bilateral level** Moldova has signed about 50 bilateral agreements, which foresee scientific cooperation in different forms: sharing of information, mobility schemes, joint calls etc. The vast majority of them are oriented towards developing contacts and networking through mobility grants. Many of them, however, do not have a practical impact and remain at the level of intentions. ASM has focussed on cooperation with some of the EU member states and has established joint R&D funding programmes with France, Germany, Italy and Romania. A series of actions on mobility and training in R&D takes place in cooperation and with the support of Estonia. Cooperation agreements are in place with a range of partner academies of sciences, which include exchange of researchers in all different scientific fields. The academy has concluded such agreements with the academies of sciences of Austria, Bulgaria, Czech Republic, Hungary, Poland and with the Royal Society of the UK. Bilateral R&I cooperation with Romania and Germany are the most important in terms of funding activities in the most recent years. Besides the EU, Moldova has traditionally strong R&D cooperation with Commonwealth of Independent States (CIS) countries. The scientific cooperation with Russia, Belarus and Ukraine is institutionalised through joint funding programmes. Bilateral R&D cooperation with Russia is the longest lasting and has been the most important among non-EU countries, but cooperation with Belarus is the most important in terms of frequency of funding activities. In 2014 joint bilateral programmes with Germany, France, Italy, Romania, Ukraine and Belarus were funded.

Regarding Transnistria, its limited R&D capacities are focused on cooperation with Russia. The Transnistrian University uses the standards and methodologies of the Russian higher education

system and has cooperation agreements with Moscow State University and other Russian universities.

Thematic priorities at the national level and for international cooperation are defined rather broadly in Moldova. The same holds true for bilateral funding programmes, although priorities vary slightly, depending on the partner organisation. Because the EU's Programmes for RTD are seen as the main instruments for international cooperation, the thematic priorities defined in the Horizon 2020 are getting increasingly important. The R&D Strategy foresees measures to align the national R&I system to developments at the EU level (e.g. the six societal challenges of Horizon-2020 are envisaged to be addressed). But thematic priorities depend also on the R&D capacities available in the country, where fields like agriculture, physics, chemistry, ICT, and materials may be mentioned.

7.3 Mobility

Mobility of researchers is stimulated mainly through international projects, especially through the bilateral R&D funding schemes, which have been put in place by the academy with certain countries. Another measure for researcher mobility has been imposed on research organisations accredited with the CNAA: expenditure on mobility and on the purchase of equipment must be not less than 20% of the expenditure of a research organisation in order to be accredited.

By way of cooperation schemes foreign researchers come for short term stays to the country. They have definitely helped to increase short term inward mobility of foreign researchers to the country and to counterbalance to a limited extent the usual mobility pattern, where only Moldovan researchers move abroad. However, Moldova remains unattractive as a destination for research. There are, de-facto, no foreign researchers working in Moldova and it will be difficult in the near future for Moldova to attract foreign researchers, because of the dire conditions such as low salaries, outdated equipment, and teaching overload in universities under which research has to be performed. A little better is the situation with foreign doctoral students, who constitute 14% of the total.

Since 2008, the ASM has been implementing initiatives to develop the cooperation between scientists still working in the country and the **Moldovan "Scientific Diaspora"**. Two international projects are relevant in this context:

- Connecting the Moldovan scientific diaspora to the development of the country of origin, financed within the Swiss SCOPES Programme. Within this project an online platform named "Diaspora Network" was designed for researchers originating from Moldova. It provides an opportunity to communicate and exchange knowhow between the diaspora outside the country with the researchers in Moldova.
- Addressing brain-drain through temporary return of expatriated Moldovan scientists and overseas young researchers to strengthen Moldova as a R&D hub and to promote temporary and permanent return and skill transfer, funded by the European Union and implemented by the International Organization for Migration. Within this project short term research and teaching visits of 7 to 11 days were organised for representatives of the Moldovan scientific diaspora.

8. INNOVATION ACTIVITIES

Current framework conditions such as strained public budgets, limited number of innovative companies, low R&D expenditure of business, and migration of qualified personnel abroad are not very conducive to innovation activities. The **cooperation between research and business got disrupted** to a large extent as a result of the transition phase, through which the economy has been passing since Moldova became independent. In this transition phase, the division of labour between companies and R&D institutes within the Former Soviet Union broke down and Moldovan companies got disconnected from customers in this region. R&D intensive state owned companies had to focus on the production of goods, which could be sold under market conditions. Several did not succeed in this endeavour and were shut down, and those which were more successful in this adaptation process did cut back on R&D expenditure. Public R&D funding was reduced drastically and therefore not any more available for stimulating cooperation between research institutes and business, let alone for support of private R&D.

Today, **research is not sufficiently integrated with other components of the innovation system** and operates rather separately of economy and education. A linear conception of the innovation process is an obstacle for the integration of various stakeholders (OECD, 2011) and for networking of the R&D sector with the rest of the economy. The public R&D sector is not

sufficiently oriented towards the economic and social needs, and research results are often not relevant to companies. The universities are traditionally focused on education, while research is gaining only slowly importance for them. They have limited collaboration with both R&D institutes and business. Furthermore, the curricula are not always in line with the needs of the industry. The universities and research institutes have limited experience and capacities for patenting, licensing, start-up companies and other commercialisation efforts. The low level of development of connections between firms and universities and of clusters is confirmed by the score obtained by the country on the indicator University-industry collaboration in R&D in the Global Competitiveness Report 2015-2016, where the country is placed at position 123 out of 140 (WEF, 2015). For a more effective implementation of innovation policies and support, the activities of the Ministry of Economy, of the Academy of Sciences, and of relevant agencies would have to be better coordinated.

The main support for public-private knowledge transfer and stimulation of innovation activities is provided by the stimulation instruments of the **Agency for Innovation and Technology Transfer (AITT)**.⁴ It was established in 2004 for coordinating, stimulating and implementing technology transfer and innovation activities. The agency is part of the ASM. Its main innovation support instrument is an annual call for **Innovation and Technology Transfer Projects**, which link up research organisations with companies. Supported projects foster collaboration between research institutions and companies to test and implement scientific solutions in practice. In this scheme the funding of the research organisations is covered by AITT, while the business partners need to provide co-funding of 50% of the overall project cost. Other stimulation instruments of the agency concern awards for the best innovations of the year, business plan competitions, innovation vouchers, and an online virtual market of inventions and technologies.

Another innovation support measure was introduced in 2007 with the Law on **Science and Technology Parks, and Innovation Incubators**. As a result of the law, the following support instruments were operational in 2014:

- **Three scientific-technological parks:** Technopark Academica (no specific thematic focus); Technopark Inagro (specialised in ecological and intensive agriculture); and Technopark Micronanoteh (specialised in nanotechnologies and microelectronics);
- **Seven innovation incubators**, most of them established in the last years: „*Inovatorul*” (2007) at ASM; „*Politehnica*” (2011) at Technical University of Moldova; „*Nord*” (2012) at State University of Balti; „*Innocenter*” (2012) at State University of Comrat; „*Inventica-USM*” (2012) at Moldova State University; „*Antreprenorul Inovativ*” (2013) at Institute Selectia in Balti; and „*Media Garaj*” (2014) in Chisinau.

The residents of technoparks and incubators are approved by the SCSTD. They benefit from fiscal incentives, low tariffs on leasing of premises and on public utilities, and the intellectual property agency AGEPI covers 95% of their patenting costs. In 2014, 33 companies held resident status in technoparks or in innovation incubators.

In general, **support for spin-offs and availability of venture capital or business angels are weakly developed in Moldova**. Few universities have established technology transfer offices. For example, the Technical University of Moldova has established the sub-division Technical-Scientific Center of Advanced Technologies Implementation "Etalon". The centre was created on the basis of a former factory within the military-industrial complex of the Soviet Union.

The efforts to link research to business refer to technology transfer rather than to other types of knowledge transfer. However, these technology transfer partnerships are still underdeveloped. The scope of AITT's initiatives is limited and their results are still uncertain (OECD, 2011). Tax incentives for residents of S&T Parks and Innovation Incubators were introduced by law, but were never applied in practice because of different interpretations of the law. The impact of Innovation and Technology Transfer projects supported by AITT is limited by the modest public budget available for the programme and the difficulty of attracting project partners and funding from the private sector. In addition there is no clear mechanism that regulates how benefits and intellectual property rights of authors are shared, in case of co-financing from the private sector (ERAWATCH, 2014). A favourable legal environment for spin-offs from research organisations and universities and for new start-up firms is missing. Inter-sectoral mobility from public to private sectors means usually not a continuation of research in the private sector, but a movement to better paid positions in the economy.

4 See: <http://aitt.md/en/>

The action plans for implementing the **Innovation Strategy (2013) and the Strategy on SMEs (2012) envisage the improvement of cooperation in the knowledge triangle education-research-business**. They include state programmes to support start-ups and introduction of innovation vouchers, innovative investment schemes such as venture capital and business-angels, public procurement of innovative goods and services, mobility business-research, and other measures. A law on venture funds and for support for linking Moldovan SMEs with funders and “business angels” is planned to be developed.

Access to finance is a challenge for innovation policy in Moldova. The general public budget or the budgets of Moldovan organisations do not include a specific financing line for innovation. The National Bureau of Statistics does not calculate any indicator on innovation funding. It is therefore difficult to estimate the volume of innovation funding and to assess the balance between research and innovation funding. Only the AITT budget is assigned exclusively to the promotion of innovation. But AITT funding does not exceed 5% of total R&I funding from public sources.

The majority of support measures target PROs and only few stimulate business R&D and innovation activities. „However, the design of these support schemes is not particularly focused on stimulating research within private companies (OECD, 2011). Private firms are practically excluded from governmental funding for R&I, since only entities accredited by the CNAA can receive public funding for R&D. The accreditation criteria are strictly oriented to academia, and thus irrelevant to the business sector’s interests and capacities. A regular evaluation and benchmarking of funding schemes is not done.

Funding from abroad, in particular from international banks and agencies for international development, has a considerable importance (PRO INNO Europe, 2011). With this support and that of the Ministry of Economy, the **Organisation for Small and Medium Enterprises Sector Development (ODIMM)**⁵ developed certain schemes providing finances:

- **PARE 1+1** - to attract remittances to the economy and to mobilise human and financial resources of migrant workers. The amount of grants awarded in 2014 was more than €2m and investments of migrants – more than €6m;
- **National Economic Empowerment of Youth** - for the establishment of start-ups, and support of young entrepreneurs in rural areas. In 2014 were approved 348 sub-loans amounting to €5.4m, including grants of €2.2m;
- **Credit Guarantee Fund** - for start-ups the guarantee is 70% of the loan and the guarantee period lasts for up to 3 years. During 2014, its capital increased by €1.1m and reached €3.1m.

Under these support schemes, innovation activities also receive financing, but there is no separate accounting for them.

Bank financing remains the main source of external funding for companies, particularly for SMEs with growth needs which cannot be covered by microfinance. Credit penetration is limited compared to similar economies and a large number of companies consider the lack of access to credit as a significant obstacle to their development. Difficulties in accessing bank lending result in limited investment potential of companies and hamper related gains in productivity (OECD, 2011).

The available innovation stimulation measures reflect a focus on the supply-side of innovation policy, while only few demand-side policies are implemented in Moldova. For the demand side, **regulation and standardisation** have become quite relevant through the national programme to adopt international and European standards. The government programme underpins this priority of harmonisation of national legislation and practices with European ones. This process is top-down driven by government and not based on voluntary cooperation among industry, consumers and public authorities. A more advanced sector in demand-side policies is the renewable energy sector, where some actions implement international environmental and energy saving standards.

Moldova has a relatively **well-regulated framework of Intellectual Property (IP)**, coordinated by the **State Agency on Intellectual Property (AGEPI)**⁶. In the period 2007-2010 the regulatory framework related to the IP was revised, and six special laws harmonised with EU legislation, so that the national legal framework is in line with the Community rules (NIP Strategy,

5 See: <http://www.odimm.md/index.php>

6 See: <http://www.agepi.gov.md/>

2012). However, implementation of legislation is a critical factor. The main impediments to full approximation in Moldova to EU standards relate to inadequate coordination of enforcement agencies, the absence of a strategic direction to enforcement, staffing and other resource constraints, the continued need for training of enforcement bodies and for awareness raising initiatives, and the absence of sufficient engagement of right holders in the enforcement effort. (Stuart et al, 2010).

According to the annual reports of AGEPI, there is **an increasing interest in patenting activity at the national level** over the recent years. This is due to „short-term patents” for which the relevant procedure is simpler, faster and cheaper than the usual one. Most of the patent applications belong to the Universities and R&D Institutes (54% of the total number in 2003-2011). Only a small percentage (4%) of the total number of patents is filed by business enterprises. Shortages of qualified attorneys and specialized consultants on IPR issues often result in a modest quality of the applications filed. Moreover, **the level of implementation remains low**. Overall, in the last 6 years, the total number of granted titles of protection (mostly utility certificates, trademarks and to a lesser extent industrial designs) has decreased, as a result of the de-industrialisation of the country.

In order to promote the IP system AGEPI organises training courses on IPR issues, as well as campaigns, exhibitions and other events for dissemination of information, and it allocates prize awards. The accredited R&D organisations have at least one person responsible to provide support for patenting, commercialisation and implementation of patents.

9. RESULTS

The **performance of the national R&D system is modest** in the European context. The limited available human and financial resources in Moldova have obvious repercussions on the quality and excellence of knowledge production. In 2014 the Moldovan R&D system produced about 1,669 articles in national journals, over 1,757 articles in journals abroad and 171 patents (SCSTD, 2015). However, these results are poorly recognised internationally. In the Scopus database in the period 1996-2014 only 5,506 documents of Moldovan researchers are listed, which ranks Moldova on the 99th place in the world on this criterion and on the 105th place by citations (SJR, 2015). In the other major database, Thomson Reuters (ISI) Web of Knowledge, the performance of the national R&D system is also fairly low and according to the number of publications per million inhabitants the indicator for Moldova is 6 times lower than the average for new EU members and 15 times lower than the overall EU average (Cuciureanu, 2011). International cooperation is particularly important here, as about 70% of papers of Moldovan researchers have co-authors from abroad.

The **number of granted patents of Moldovan researchers is relatively high** compared to the number of population and the size of the economy – almost 3,000 patent applications in the period 2000-2013 (WIPO, 2015). However, **only less than 1/3 had a duration of over 5 years**. The small number of renewed patents is explained partially by the remission from taxes for a period of five years, which applies for Moldovan researchers. Other reasons for this situation are the low applicability of registered inventions (determined by the profile of the Moldovan economy), the weak links between business and R&D sectors, and, in general, by a low innovation culture. The number of patent applications at foreign patent offices is marginal. For example, in 2000-2013, only five patents were granted for Moldovan researchers by the European Patent Office, and only five patents granted by the United States Patent and Trademark Office (WIPO, 2015). This can be explained by the high cost of registration and the fact that Moldovan researchers working in collaboration with foreign partners are rarely listed as first inventor.

The **economic effects of outputs are rather limited**. High-technology exports only represented 6% of manufactured exports in 2011 (World Bank, 2015). On the other hand, the share of computer and communications services in total exports of Moldovan services is relatively high (33.8%) and comparable with Eastern European countries (EEC). This indicates a high competitive potential of this sector.

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This report summarise evidence on the situation in the field of science, technology and innovation (STI) in Moldova in the form of the background report that fed into the PSF Peer Review of Moldova's research and innovation system, conducted between November 2015 and May 2016 by a panel of independent experts and national peers.

Studies and reports

