



Peer Review of the Moldovan Research and Innovation system

Horizon 2020 Policy Support Facility



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List of acronyms

AGEPI	State Agency on Intellectual Property of the Republic of Moldova
AITT	Agency for Innovation and Technology Transfer
ANCDITT	National Agency for R&D, Innovation and Technological Transfer
ANCI	National Agency for Research and Innovation
ASM	Academy of Sciences of Moldova
CEE	Central and Eastern Europe
CEEC	Central and Eastern European Countries
CFCFA	Center for Fundamental and Applied Research Funding
CIP	Center of International Projects of ASM
CIS	Commonwealth of Independent States
CNAA	National Council for Accreditation and Attestation
CREST	European Union Scientific and Technical Research Committee
DCFTA	Deep and Comprehensive Free Trade Area
DG	Directorate General
ERA	European Research Area
ERAC	European Research Area Committee
ERA-NET	European Research Area Network
ESIF	European Structural and Investment Funds
EU	European Union
EUROSTAT	EU's Directorate General for Statistics
FASO	(Russian) Federal Agency for Scientific Organisations
FDI	Foreign Direct Investment
FEN	National Environmental Fund
FP7	EU 7th Framework Programme for Research
FTE	Full Time Equivalents
GCR	Global Competitiveness Report
GDP	Gross Domestic Product
GERD	Gross Expenditure in Research and Development
GUF	General University Funds
H2020	Horizon 2020: The EU Framework Programme for Research and Innovation
HEIs	Higher Education Institutions
HR	Human Resources
IncoNet EECA	International cooperation Network for Eastern Europe and Central Asia
IP	Intellectual Property
IRC	Irish Research Council
ITT	Innovation and Technology Transfer
JPI	Joint Programming Initiative
MOST	Moldovan Office for Science and Technology
NCBiR	National Centre for Research and Development
NCN	National Science Centre (Poland)
NGO	Non-Governmental Organization
ODIMM	Organization for Small and Medium Enterprises Sector Development
OECD	Organization for Economic Cooperation and Development
PAS	Polish Academy of Sciences
PRO	Public Research Organization
PSF	Horizon 2020 Policy Support Facility (EU instrument)
RAS	Russian Academy of Sciences
R&D	Research and Development
R&I	Research and Innovation
RTDI	Research, Technological Development and Innovation
SCSTD	Supreme Council for Science and Technological Development
SMART	Specific, Measurable, Achievable, Relevant, Time-bound
SME	Small and Medium-Sized Enterprise
SRSS	Structural Reform Support Service (EU instrument)
TAIEX	Technical Assistance and Information Exchange (EU instrument)
TRL	Technology Readiness Level
WEF	World Economic Forum

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1 POLICY MESSAGES

The PSF expert panel (the Panel) arrived at the following **seven Policy Messages**, supported by the **twenty-four** detailed recommendations presented in this report. This section presents the rationale supporting each of the seven policy statements. The recommendations in this report aim at strengthening the Moldovan R&I system by addressing a set of structural weaknesses and by building on Moldova's existing and potential strengths.

As a general note, the Panel considers that the present situation of the research and innovation (R&I) system of Moldova constitutes a bottom-line which by no means should be further downgraded. The country needs adequate support for its R&I capacity building, swift implementation of long-awaited national reforms in structure, governance and functioning of the R&I system, and a careful nurturing of the human resource base. These are three crucial pillars for Moldova's economy to directly benefit from the high economic added value that the country's knowledge capacity is able to generate.

In addition, the Panel would like to emphasize that Moldova experiences a unique window of opportunity for smart reforms. These are eagerly expected by all stakeholders of the Moldovan R&I system, be it researchers or academicians, politicians, civil servants running the programs, NGOs or entrepreneurs. The momentum should be reaped for tough and committed reforms. The country's intellectual and innovative capital should not be squandered since it is a source of growth. Applying cosmetic reforms might be a deadly cure for the Moldovan R&I system.

In line with this framework, the Panel considers that Moldova should:

1. **Embed Research and Innovation (R&I) policy in the overall economic policy strategy of the country.** Improving synergies between Moldova's R&I strategy and the country's overall socio-economic ambitions is key. This cannot be reached without ambitious reforms of the national R&I system, strong and determined priority-setting, and continuous involvement of stakeholders in order to generate an ownership of these reforms.
2. **Improve the governance of the national R&I system by strengthening the political responsibility for R&I with a dedicated Ministerial responsibility.** The panel is not convinced of the added value of the inter-ministerial Council for R&I announced by the government.
3. **Create an independent, transparent and accountable R&I implementation Agency** which concentrates and allocates all available R&I funding on the basis of international standards. The combination of a Ministerial responsibility for R&I policy-making with an independent Agency that manages R&I funds will allow the Moldovan Academy of Sciences to focus on its role as major research performer in the country.
4. **Redress the *binary* research and education system of Moldova**, whereby universities are mostly concentrated on "teaching" and institutes on "research". The circulation of knowledge and human resources throughout the country's public system is now more essential than ever before. Incentives for cooperation between universities (where the young generation studies) and research institutes (with ageing research staff) should be a driving force of the reforms.
5. **Safeguard the public R&I capacity of Moldova** by ensuring that the physical, intellectual and human capital of its research institutions is maintained and eventually reinforced. In return, systematic evaluation procedures for public research organizations and higher education institutions should be set up to progressively link public R&I funding to performance in the medium-term, thus rewarding quality research. In addition, the share of competitive funding allocated to R&I needs to be increased to stimulate competition.
6. **Take resolute action to improve the employment and funding opportunities, working conditions and career perspectives of researchers**, including notably young and female scientific talents. Open and merit-based recruitment practices and structured and high-quality PhD programs are essential to modernize the system. Salaries, in particular for entry levels, should be revisited and scientific achievements should be rewarded.
7. **Urgently review the framework conditions for innovation by putting in place a coherent set of policy measures** to create and stimulate a supportive environment for business engagement in R&I activities, including both non-financial tools (a legal environment supportive of spin-offs and knowledge transfer, better opportunities to fund risky projects) and the increased use of public funding to leverage business R&I activities. In relation to the latter, the panel is of the opinion that the artificial administrative barrier of accreditation for allocating R&I funds to the business sector should be abolished.

The aim of the panel recommendations is to preserve and enhance the best of the Moldovan R&I system and to unlock the potential of existing resources towards excellence but also relevance of R&I for the Moldovan economy and society.

The panel would like to emphasize that **the proposed reforms can only work in practice if they are accompanied by adequate funding** to allow Moldova to make the most of its knowledge capacity, for sustainable economic growth. The panel proposes that the country gradually increases its R&D intensity to reach the level of 2007 as quickly as possible from *the current level 0,40%, which is considered an absolute minimum*. Although this increase is not seen as optimal and is far below the national target of 1% by 2020, it would be perceived as sending the right signal in terms of political commitment to the proposed reforms.

To derive these policy messages and the recommendations that underpin them, the Panel relied on a number of guiding principles. *First*, reforms should not create a risk of deteriorating the physical, intellectual and human capital currently existing in the Moldovan R&I system, built through periods of hard work and hardship. *Second*, the reforms should target the efficiency of public spending on R&I with lean and simple administrative structures and transparent procedures accompanied by effective financial instruments. *Third*, the political accountability of the system is vital. *Fourth*, only through high quality science based on competition, performance and merit, and through impactful innovations incentivized through adequate framework conditions, will the country's R&I system be in the position to strongly support the economic development of Moldova. *Fifth*, Moldova's human resource capacity is a crucial asset of the nation; decent salaries, career opportunities and supportive working conditions for researchers are essential to avoid brain drain and the progressive depletion of its intellectual assets. And *sixth*, promoting an evaluation and a performance-oriented culture must be at the heart of the reforms, both in terms of measuring institutional and personal achievements.

The operational recommendations proposed by the Panel aim at providing concrete guidance for implementing the seven policy messages outlined above. As stated above, they address the system's structural weaknesses and build on existing and potential strengths, fully utilizing up-to-date expertise on R&I policy formulation, implementation and evaluation, as well as good practices applied in EU Member States.

The section below explains the rationale behind the seven policy messages proposed by the Panel.

1. Embed Research and Innovation (R&I) policy in the overall economic policy strategy of the country. Improving synergies between Moldova's R&I strategy and the country's overall socio-economic ambitions is key. This cannot be reached without ambitious reforms of the national R&I system, strong and determined priority-setting, and continuous involvement of stakeholder in order to generate an ownership of these reforms.

Moldova's overarching National Development Strategy 2020 acknowledges R&I as a key contributor to the societal and economic development of the country. However, R&I is only weakly addressed in the context of national reforms of the higher education system, to give an example. Moreover, the framework conditions for innovation in Moldova are not supportive of business engagement in R&I activities and neither conducive to science-business cooperation. The National R&D Strategy of 2014, the Innovation Strategy of 2013, the SME Strategy 2012-2020 of 2012 are all relevant policy documents but they enjoy weak synergies between each other and appear –as a whole- often as standalone "visions" of policy-makers or stakeholder groups, unlinked from the overall economic strategy.

Therefore, the panel believes that R&I policy must be embedded in the overall economic agenda of Moldova. Knowledge capacity building should also serve an overall societal purpose and generate economic opportunities, beyond reinforcing the system's scientific power. There is a therefore a need for a critical review of both existing strategic "sectoral" documents and the further roll-out of the country's overarching development strategy to secure a more integrated, coherent and aligned set of priorities and implementation measures for R&I policy needs and ambitions. In addition, R&I policy implementation should be "SMART" and accompanied by clear monitoring mechanisms.

The country should nurture a structured and sustained dialogue with stakeholders to reinforce trust in a coherent set of R&I policy strategies. The public perception of the role of R&I as a contributor to the socio-economic development in Moldova is low with so far limited efforts by the public authorities to redress that. In that respect, more frequent public consultations on R&I matters, science popularization and incentivizing scientific careers throughout the education system will support a positive public perception of R&I as a driving force of socio-economic progress. The active participation of stakeholders in developments linked to the R&I system of the country will secure ownership and support in the national efforts to ambitiously reform the R&I system.

2. Improve the governance of the national R&I system by strengthening the political responsibility for R&I with a dedicated Ministerial responsibility. The panel is not convinced of the added value of the inter-ministerial Council for R&I announced by the government.

The development of the R&I system of Moldova has undergone over the past years different phases. At one point it was administered by the Ministry of Economy, subsequently by the Ministry of Education, then by a dedicated non-affiliated department in the government, and as of 2004 by the Moldovan Academy of Sciences (ASM) since the Parliament enacted the Code on Science and Innovation. The current governance of the R&I system is based on the ASM, which somehow de facto fulfills the role of a Ministry of Science. However, the ASM is at the same time: the policy developer; the institution that manages and implements the lion's share of public R&I funds; and the main research performer. This results in a clear institutional conflict of interest for the ASM.

In addition, several Ministerial departments (Finance, Economy, Agriculture and Food Industry, Environment, Health and Education) claim a role in R&I policy setting and funding. Although this could be seen as a positive development, the current lack of a coherent and coordinated approach to R&I policy design and, notably to policy implementation, is not conducive to harmonious and synergetic developments in the operational roll-out of public R&I funding programs. However, the line Ministries also manage a number of dedicated institutes that implement research and get funding. Therefore, they are equally in a conflict of interest situation, although of smaller intensity given the volume of funds and the number of institutes that they manage.

Therefore the panel proposes to establish a Ministerial responsibility for R&I policy. It considers that a single Ministry (in the optimal case) should assume this responsibility and be renamed accordingly. The Ministry should be provided with sufficient resources -including human resources- to run the R&I policy-making and strategy development, and with adequate funding to be channeled through the Agency proposed by the panel. Substantial advice will be needed for establishing the Unit/ s responsible for R&I policy within the Ministry. Support from ASM, including advice and possibly the transfer of qualified human resources, as well as EU and/ or international expertise will be required.

The move to such a new Ministerial responsibility should be accompanied by the creation of an implementing Agency for R&I.

The Panel believes that the present coordination mechanisms at the level of the government combined also in the future with coordination at the level of the Board of the Agency for R&I, will be sufficient and therefore an added value for the proposed inter-ministerial Council for R&I is not evident.

3. Create an independent, transparent and accountable R&I implementation Agency which concentrates and allocates all available R&I funding on the basis of international standards.

Currently practically all the state budget allocated to R&I activities is managed by the ASM through the Center for Fundamental and Applied Research Funding (CFCFA), which allocates the lion's share of the state budget dedicated to semi-competitive (institutional) and competitive (calls for proposals) funding addressed to the Moldovan R&I community, i.e. to universities, ASM's institutes, branch research institutes under line Ministries, NGOs and, to a minor extent, to the business sector.

The largest share of the state R&D budget is allocated to the operating costs of ASM's research institutes (via institutional funding). This share is reported to reach "50 to 60%" or even more, according to the panel's findings. A high share of this funding appears to be in the form of personnel costs for researchers, while the remaining share is distributed through competitive calls. Sheer competitive funding through peer-reviewed projects was reduced in recent years from 16.3% in 2010 to 8.4% in 2014.

In line with the view of all major stakeholders in Moldova, the Panel recognizes the need for establishing an independent R&I Agency under a suitable Ministry. A direct subordination of the Agency to the government itself is also an option, but this could lead to a more blurred distribution of responsibilities among actors (government as such, Ministry and Agency). The main aim of the Agency should be the implementation of R&I policy funding, notably through calls for proposals and through institutional funding for R&I, the latter increasingly against performance. The peer reviewed evaluation of project proposals by the Agency shall be carried out under well-established and transparent international peer review practices. The Agency should also be in charge of the periodic evaluation of public research and higher education institutions.

The independent character of the Agency needs to be secured. It needs to have full responsibility and autonomy for the allocation of funding and for the proposal selection process, fully respecting the principle of transparency. The Panel strongly recommends channeling the whole public institutional and competitive R&I funding through the R&I Agency avoiding a thin spread of the (limited) national public R&I funding through Ministries and other entities, since this reduces impact, transparency, accountability as well as soundness of evaluation procedures.

The share of competitive funding managed by the Agency should be increased from the current levels as a means to stimulate competition and reward the most promising proposals and research teams. However, this should be based notably on additional public investments in R&I and not through a reduction of the already meagre R&I budget of the country, as this would risk deteriorating the R&I capacity and its economic impact.

The combination of a Ministerial responsibility for R&I policy-making with an independent Agency that manages R&I funds will allow the Moldovan Academy of Sciences to focus on its role as major research performer in the country. This reform will notably address the institutional conflict of interest that places ASM (and the line Ministries) in the position of policy-maker, funding agency and major research performer in the country.

4. Redress the binary research and education system of Moldova, whereby universities are mostly concentrated on "teaching" and institutes on "research". The circulation of knowledge and human resources throughout the country's public system is now more essential than ever before. Incentives for cooperation between universities (where the young generation studies) and research institutes (with ageing research staff) should be a driving force of the reforms.

The modernization of the R&I system of Moldova can significantly contribute to increasing its efficiency. The current strong segregation between teaching and research activities, which is to a very large extent a legacy from Soviet times, has led to a binary education system. Such a system is considered outdated by the panel since there is a clear need for a consistent "osmosis" in terms of knowledge circulation between the research and the education parts of the system in order to boost research performance with economic impact. However, the transition towards a synergetic education and research system is generally complex and in several cases considerable barriers still exist. Removing those barriers in Moldova will certainly contribute to a better use of its skilled human resources and to the optimal use of research funding and research infrastructure.

To start with, Moldova should put in place strong incentives for cooperation and mobility between research institutes and universities to overcome the barriers linked to country's fragmented system. The need for enhanced cooperation between institutes and universities is widely recognized in Moldova and is fully endorsed by the Panel. To succeed in this *rapprochement*, it is crucial to avoid a further reinforcement of teaching-solely universities with a high concentration of young talent and research-only institutes with an ageing researcher population, incentives should be developed to create a fully functional, duly integrated and permeable national research area.

Such incentives could include competitive calls for joint research institutes and universities; strengthening PhD study programs as a bridge between institutes and universities; making research infrastructure of institutes available to all the research community and in particular to students as well as to the private sector; mobility actions between institutes and universities.

5. Safeguard the public R&I capacity of Moldova by ensuring that the physical, intellectual and human capital of its research institutions is maintained and eventually reinforced. In return, systematic evaluation procedures for public research organizations and higher education institutions should be set up to progressively link public R&I funding to performance in the medium-term, thus rewarding quality research. In addition, the share of competitive funding allocated to R&I needs to be increased to stimulate competition.

Most of the research capacity in Moldova is under the ASM or closely related to it. In addition, nineteen academy institutes and fifteen research institutes are directly administratively subordinated to different Ministries (the former 'branch research institutes'). Both types are scientifically supervised and receive funding from ASM, based on specific accreditation by the National Council for Accreditation and Attestation (CNAA). Funding allocation for the Ministry institutes has been shifting in 2015-2016 from the ASM to the Ministries. The national higher education system in turn includes thirty-one institutions, i.e. nineteen state and twelve private universities. Since the number of enrolled students is constantly decreasing since 2006, a re-organization process of the sector is on-going with merging or closing of entities. The universities also need to be accredited by the CNAA to receive funds from the state budget.

The panel recommends to safeguard the current public research and innovation capacity of Moldova as an *absolute minimum*, ensuring that the physical, intellectual and human capital of Moldovan research institutions is maintained, and eventually reinforced. Notably the research capacity and political independence of the ASM, as the country's leading research performer, should be preserved, as well as the research capacity of institutes under Ministries and of universities, to avoid a dangerous downgrading of the country's knowledge base and its impact on the socio-economic development of Moldova.

Maintaining the *status quo* or excluding certain institutes or research units from a restructuring is not an option. At the same time, these institutions need to significantly enhance their accountability, while the autonomy of ASM and of the public universities should be preserved. To ensure continuity in R&I capacity, the institutional funding of the system should be commensurate to the current situation of the different actors. This is notably relevant for the ASM, for example, which holds most of the country's research infrastructures. It is also the case for public universities and research institutes under Ministries, which will need to receive appropriate funding for improving their research capacity. Measures should be taken, in addition, to ensure that ASM remains in possession of its research-devoted assets and infrastructure, such as buildings and land. Measures should be put in place so that the funding for all public research institutions (ASM, research institutes, and HEIs) should be based on and in relation to performance evaluation.

6. Take resolute action to improve the employment and funding opportunities, working conditions and career perspectives of researchers, including notably young and female scientific talent. Open and merit-based recruitment practices and structured and high-quality PhD programs are essential to modernize the system. Salaries, in particular for entry levels, should be revisited and scientific achievements should be rewarded.

The panel considers the situation of the human resource capacity for R&I in Moldova as alarming. The national R&D strategy openly points to a set of weaknesses: the research community has been shrinking, intense brain-drain has occurred internally and externally, research careers are not attractive for young researchers, and the research community is strongly ageing. The overall numbers for R&D personnel have decreased five-fold since the country's independence to reach 5,038 in 2014. The number of researchers per 1 million people is 4.5 times lower than in EU. This gap is likely to widen, given trends of emigration of talented young researchers and low attractiveness of scientific careers. This resulted in a five-times lower output of new doctorate graduates per 1000 people aged 25-34, in relation to the EU average. As a result, Moldova is now one of the few European countries where the number of PhD students decreased from 2004 to 2010. And all this in spite of a relatively high share of population with tertiary education.

The Panel recognizes the urgent need to introduce measures to improve the employment and funding opportunities of researchers, including the need to systematically introduce open and merit-based recruitment practices, structured and high-quality PhD programs, adequate rewards and social recognition for scientific achievements and careers. In particular, young and female scientific talent should be nurtured. At the same time working conditions and career perspectives of researchers should be revisited and strengthened, including notably the particularly low salaries for entry levels. The system should also provide the most experienced researchers with increased leadership perspectives. Mobility measures are also needed, in particular in relation to return conditions for scientists from the Moldovan scientific diaspora. Mass media actions and extension of successful grassroots activities such as the "Science Slam" are key in this respect.

7. Urgently review the framework conditions for innovation by putting in place a coherent set of policy measures to create and stimulate a supportive environment for business engagement in R&I activities, through non-financial tools (a legal environment supportive of spin-offs and knowledge transfer, better opportunities to fund risky projects) and an increased use of public funding to leverage business R&I activities. In relation to the latter, the panel is of the opinion that the artificial administrative barrier of Accreditation for allocating R&I funds to the business sector should be abolished.

In Moldova, the innovation capacity of business and in particular the participation of the business sector in research activities remains marginal. Modest investments of the business sector in R&D are determined largely by the structure of the economy, with a concentration on low-tech sectors, and by the distribution of the foreign direct investment, which are both not favorable for R&D activities. Low cost continues to be the main source of competitiveness. Innovation in industry and in services is based mostly on foreign equipment and technology acquisitions instead of in-house technological solutions, since few Moldovan enterprises possess innovation departments.

The majority of support measures taken so far for improving the framework conditions for R&I in Moldova target the supply-side of innovation (public research organizations) and only a few stimulate business R&I activities (direct funding for business R&I and demand-side measures). Moreover, private firms are practically excluded from governmental funding for R&I, since only entities accredited by the CNAA can receive public funding for R&I. The accreditation criteria are oriented to academia and are not relevant to the business sector's interests and capacities.

Positive developments occurred in 2007 with the Law on Science and Technology Parks, and Innovation Incubators. As a result scientific-technological parks, as well as seven innovation incubators became operational in 2014 with thirty-three companies gaining a resident status. In terms of IP protection, Moldova has a relatively well-regulated framework coordinated by the State Agency on Intellectual Property (AGEPI), and a rather high patenting activity. However, when examining the patenting data, the weaknesses of Moldovan R&I system in terms of business innovativeness are becoming evident.

The Panel agreed that innovation can flourish on the market only under business-friendly and supportive framework conditions. Such framework conditions must be a priority for the national R&I policy. The accreditation process for receiving public research funding should be abolished since it constitutes an artificial administrative barrier for the research actors and especially for the business sector and for NGOs. Appropriate innovation investment mechanisms for risk R&I investments that would otherwise not occur (including venture capital funds and business angels) should be setup in order to stimulate technology based start-up companies and business development. A mobility scheme should be implemented to allow qualified personnel from the business sector to implement short-term research in academia or to teach in business oriented courses and seminars. Reciprocally it should allow researchers, in particular PhD students, to train or work in companies for mutual benefit.

Finally, business representatives should be systematically included in the management or Advisory Boards of higher education institutions (notably universities) and public research organizations and in the Board of the independent R&I Agency proposed by the Panel. The budget of the innovation support programs currently implemented by the innovation-oriented agency "AITT" (and in the future by the proposed Agency for R&I) should increase with clear emphasis on business-driven R&I schemes. This should be accompanied by a robust selection process of proposals based on their quality, as well as by a regular quality assessment of the programs.

* * *

As a corollary, the panel would like to underline that the Gross Domestic Expenditure on R&D (GERD) as a share of GDP has been declining in Moldova over last years from a peak of 0.55% in 2007 to approx. 0.4% according to recent estimates. Public research expenditure in absolute values is also very low (Moldovan Lei 425.5 million; € 23 million) in 2014. The R&I expenditure per capita is equally low, with a meager €6.6, more than 80 times lower compared to the EU average! Such low levels of financing go against the national R&D intensity target of 1% of GDP by 2020 and are not supportive of a R&I sector capable of spurring solid economic growth.

The Panel recognizes the need to increase the R&I expenditure as a capital necessity. The implementations of the reforms proposed by the panel can only work in practice if they are accompanied by adequate funding that will allow Moldova to benefit from its economic potential deriving from its knowledge capacity. Increasing R&D investments without reforming the R&I system, or reforming the R&I system without an increase from the currently very low levels of R&D spending will yield only marginal and short-term results.

The panel therefore proposes that the country gradually increases its R&D intensity to reach the level of 2007 as quickly as possible from the current level of 0,40%, which is considered as an absolute minimum. Although this increase is not seen as the optimal one, and remains far below the ambitious national target of 1% by 2020 set by Moldova, it would send a clear signal in terms of political commitment to the proposed reforms. The present investment situation constitutes a bottom-line and in view of the panel it is mandatory to support the necessary reforms.

2 THE PSF PEER REVIEW: AIM, FOCUS AREAS AND METHODOLOGY

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

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

The Moldovan authorities expressed their interest for a Peer Review of the Moldovan national R&I system through a letter of the President of the Moldovan Academy of Sciences to the European Commission services, responsible for the Policy Support Facility, in May 2015. The PSF panel acknowledges that such move was welcomed by national research and innovation stakeholders.

The Peer Review panel worked from November 2015 to April 2016. The panel included five independent experts from Poland, Austria, Greece, Netherlands and Romania acting in their personal capacity and two peer reviewers as policy-makers from Austria and Estonia.

Aim and focus areas

In line with this request, the aim of the Peer Review was to provide external advice and operational recommendations on possible **reforms** to be undertaken within the framework of the Moldovan *National Strategy for Research and Development 2014 – 2020*.

At the request of the national authorities, the review focused on the following four main **focus areas**:

- (1) **Increasing the efficiency** of public R&I funding and the quality of the R&I performing bodies and instruments;
- (2) **Improving the policies** for human resources and mobility of researchers;
- (3) **Boosting business innovativeness** and science-business links; and,
- (4) **Increasing R&I impact** by properly defining the policy instruments.

These four **focus areas** are reflected in the chapter structure of this report.

- *Chapter 3* provides a framework for the review by outlining the current economic and R&I situation in Moldova.
- *Chapter 4* discusses focus area (4): increasing R&I impact, including the key issues of: integrating R&I with economy and society; governance of R&I as an overarching topic; as well as priority-setting and R&I statistics. It is to be noted that increasing R&I impact is also linked to improvements in the other focus areas, which are analyzed in the ensuing chapters.
- *Chapter 5* deals with how to best increase the efficiency of public R&I funding and the quality of R&I performing bodies and instruments.
- *Chapter 6* highlights the opportunities ahead for the improvement of human resources policies.
- Finally, *chapter 7* examines options for boosting innovation.

The report is rounded up with a final set of *conclusions*, an implementation roadmap and an impact assessment table.

Methodology

The PSF Peer Review followed a three-step approach:¹

First, a **preparation phase**, which involves in particular the collection of the evidence base for the review. It started by gathering and analyzing a comprehensive set of qualitative and quantitative information on the Moldovan R&I system and by mobilizing key actors (i.e. preparation phase). In this context, an overview of the challenges faced by the country, resulting from a series of meetings organized by the Moldovan Academy of Sciences in September-November 2015 (the “self-assessment” process) was presented at the kick-off meeting of the PSF exercise in Brussels on 11 November 2015, when the PSF Panel had the first opportunity to discuss the background report on the Moldovan R&I system².

Second, an **implementation phase**, when the actual Peer Review analysis took place involving both remote analyses of the information (background documents and other information collected in the first step and outlined in the section 9 of this report) in relation to the focus areas selected by Moldova and face-to-face interactions within the host country. The PSF panel carried out a first field visit to Chisinau on 7-9 December 2015 and met with all relevant Moldovan authorities involved in the design and implementation of R&I policies as well as a wide range of institutions and stakeholders (i.e. Academy of Sciences, Universities, Agencies, private entities, NGOs). A proposal for the structure, main messages and draft recommendations of the Peer Review report followed. The PSF panel presented the preliminary findings (in the form of “options for the future”) to Moldovan stakeholders during a second field visit in Chisinau on 27-29 January 2016.

The third step is the **reporting phase**. It consisted in elaborating and communicating the findings of the Peer Review in a suitable way. On the basis of the documents received and analyzed, as well as drawing on the in-depth discussions with a wide range of experts and the comments received at the meetings during the two field visits, the PSF Panel prepared the present Peer Review report. The report includes analysis and operational policy recommendations, with supporting evidence gathered in the peer review process. It also incorporates good practice and analyses of similar approaches and reforms introduced in other countries, that proved to be successful.

The panel would like to emphasize that, in line with the PSF principles, it is the **country’s responsibility to ensure the follow-up to the Peer Review as well as the potential implementation of its recommendations** through concrete reforms. In rolling out these reforms, the Moldovan authorities can continue to call upon the PSF for support and envisage the assessment of the implementation of the panel recommendations within a three-year time span through a PSF post-Peer Review. The Panel is committed to coming back to Moldova and to support the country with undertaking this assessment in about two to three years’ time.

¹ The PSF peer review methodology builds on the peer review work carried out under the auspices of the former European Scientific and Technical Research Committee (CREST) and European Research and Innovation Area Committee (ERAC), further improved during the PSF Peer Review work of the Policy Support Facility which was started by the [Peer Review of Bulgaria’s R&I system](#) (April-September 2015).

² Horizon 2020 Background Report for the PSF Peer Review of the Moldovan R&I system: “Research and Innovation in the Republic of Moldova” by Manfred Spiesberger (Centre for Social Innovation - ZSI, Vienna, Austria) and Gheorghe Cuciureanu (Information Society Development Institute - IDSI, Chisinau, Moldova), November 2015.

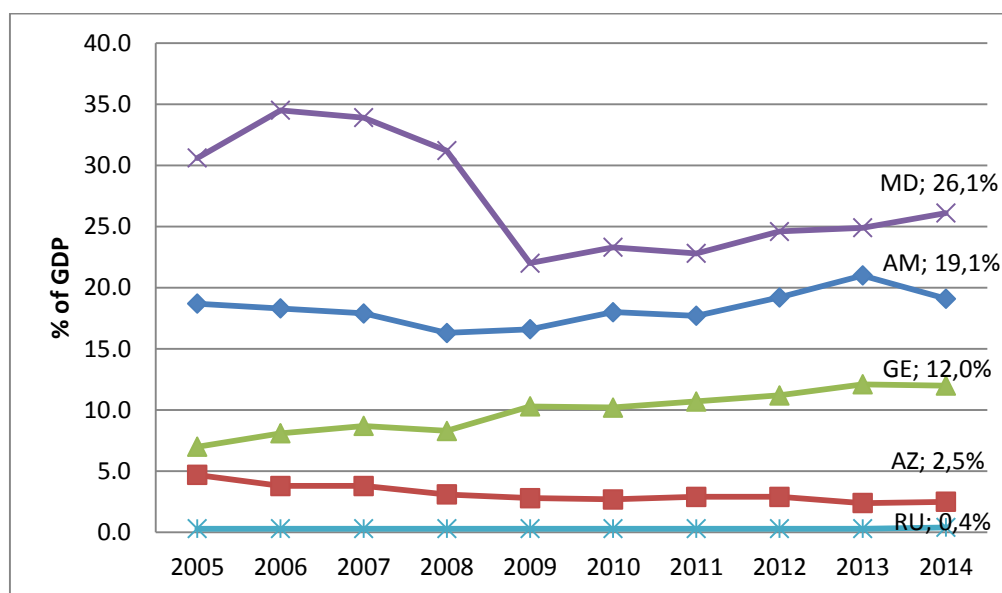
3 THE ECONOMIC AND R&I CONTEXT IN MOLDOVA

The Republic of Moldova is a small country in Eastern Europe with a population of approximately 4 million inhabitants. Since 2009 Moldova is governed by political coalitions, which all share the ambition of integrating Moldova in the European Union. However, the **political situation** has been fairly unstable in the last years. After the 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 thus formed, backed by the Communist Party. On 30 July 2015, a new pro-European majority government was established, but dismissed already on 29 October 2015.³ A new government was then sworn in, among protests, only at the end of January 2016. In addition, corruption appears as a relevant problem for Moldova, which has worsened over the recent years.⁴

The immediate years after Moldova's independence and the transition of the country to a **market economy** were very hard times. The military conflict with the breakaway region Transnistria added to these difficulties. As a result, the GDP of Moldova decreased from 1990 to 1999 by a staggering 64%, and accordingly the expenditure priorities of the government shifted, with social spending becoming more important. Today, Moldova is the **poorest European country** in terms of GDP *per capita*, which reached only \$2,239 in 2015. Moldova's GDP growth declined from a strong 9.4% in 2013 to 4.6% in 2014. For 2015 preliminary data show that the economy has slowed down further and moved into a slight recession of -0.5% of GDP.⁵

The GDP is in absolute figures equally low and depends largely on **remittances from Moldovans working abroad**. Those remittances reached more than a quarter of GDP in 2014 (26.1%), and were herewith higher than in other countries of the Former Soviet Union such as Armenia or Georgia. Comprising about 30% of the labor force, Moldova's emigrant population is in relative terms among the largest in the world (Bouton et al., 2011).

Figure 1: Remittances (%GDP) for Moldova and other Former Soviet Union countries 2005-2014⁶



Data: World Bank (2015) <http://data.worldbank.org/indicator>

- 3 The banking scandal which involved \$1billion (one eighth of the annual GDP) and led to the arrest of the PLDM leader and former Prime Minister on suspicion of fraud, is an example of this political instability.
- 4 Moldova ranks 103 (out of 160 countries) in the Corruptions Perception Index 2015 of Transparency International, and its score worsened since 2012: <http://www.transparency.org/cpi2015/>.
- 5 World Bank (2016) <http://data.worldbank.org/indicator> and Moldova Economic update, April 2016 <http://pubdocs.worldbank.org/pubdocs/publicdoc/2016/4/262511460011446842/MoldovaEconomicUpdate2016SpringEN.pdf>.
- 6 Data for Moldova (MD), Armenia (AM), Georgia (GE), Azerbaijan (AZ), and Russia (RU).

The Moldovan economy is built on a **relevant agricultural sector**, which represents 15% of GDP and 45% of commodity exports. Those exports concern in particular fruit and vegetables, oilseeds, and beverages. Besides agriculture, Moldova concentrates its economy on manufacturing, services and trading. A **promising innovative sector** for the country is Information and Communication Technologies (ICT), which has gained weight similar to that of other Commonwealth of Independent States (CIS) countries. Manufactured products account for 52% of commodity exports, with high shares in the electrical machinery, textiles and furniture sectors. The country's imports are mainly concentrated on fuel, manufactured products (electrical machinery and textiles), and agri-food products (World Bank, 2016; Stratan et al., 2015).

Moldova's main trading partner is the European Union, with about 60% of exports going to the EU and about 50% of imports stemming from the EU. The main EU partners are Romania, Italy and Germany. An association agreement was concluded in 2014 with the EU, which includes a Deep and Comprehensive Free Trade Area (DCFTA). The second most important region for Moldova's trade is the CIS, with 25% of exports going to this region (Lupusor et al., 2016).⁷ The main trading partner CIS countries for Moldova are Russia, Belarus and Ukraine. In 2014-2015 trade with Russia and Ukraine decreased significantly due to sanctions on Russia, trade restrictions of Russia on Moldova, and the conflict in Eastern Ukraine.

Moldova has a **relevant tradition of education and research**. In spite of the difficult social and economic situation since the country's independence, a functioning education and a significantly downsized research system were preserved. Cuts in education and research funding led to very low investment in these sectors over many years. When Moldovan research was no longer integrated in the large, powerful system of the Soviet Union, this led to a decline in its size, quality and outcomes. However, niches of excellence were preserved.

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

The legal basis was adapted partly to these programmatic goals. The Code of Education was revised and aligned to the goals of the government program, and adopted in 2014. A revision of the Code of Science and Innovation (dating from 2004) has however been delayed and incompatibilities of vision with the Code of Education exist.

The **Moldovan R&I system presents several structural weaknesses** such as low financing, ageing, migration and downsizing of the R&D personnel, a weak link to society's needs and challenges, insufficient possibilities for universities to perform adequate research, an almost inexistent involvement of the private sector and, last but not least, a rather unusual governance structure. These issues will be touched upon in the following chapters of this review report.

3.1 Governance of the R&I system

The development of the R&I system of Moldova underwent, **over the years, different phases**. It was administered by a number of government departments and institutions including: the Ministry of Economy, the Ministry of Education, a dedicated department in Government, and -as of 2004- by the Moldovan Academy of Sciences (ASM).⁸

The current governance attaches a **central role of the Academy of Sciences**. The Academy is the main policy-making institution and fulfills -to a large extent- the role of a Ministry of Science. The President of ASM is a member of the government. It is an elected eminent national scientist who enjoys full independence from political views. ASM works as the research policy-making body, it manages most of the public R&I funds, and is the main research performing institution in the country. The panel acknowledges the relevant contribution of ASM, as leading research institution in Moldova, in preserving a valuable research capacity in the country.

7. Data for 2015.

8 In 2004 the Parliament enacted the Code on Science and Innovation, which put the ASM in charge of R&I policy and implementation.

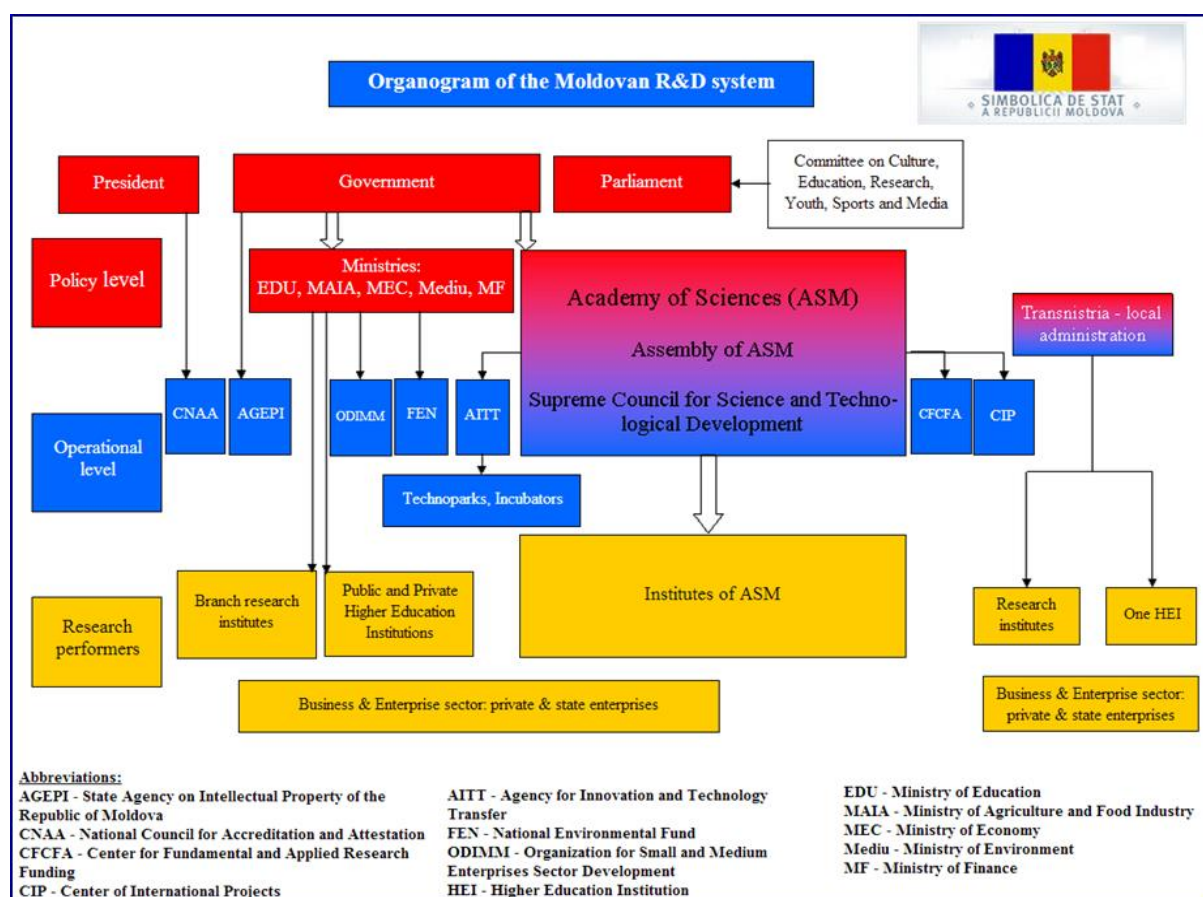
This results in a clear institutional conflict of interest, since it places ASM as policy-maker and funding agency, while being at the same time the major beneficiary of the research funds as the country's performer of the lion's share of research in the country.

This conflict of interest has been widely and sometimes passionately recognized in the interviews the PSF peer review panel carried out.

Statistical data indicate that this institutional conflict of interest has effects upon the community with **only 11% of the competitive funding being allocated to Universities**. It should be noted that even if the research capacity and potential in the ASM's institutes is high, a larger number of researchers (university professors and research staff) is reported to be affiliated to the universities rather than to ASM (70% non-ASM to 30% ASM in headcount; less in Full Time Equivalents - FTE). Therefore, fierce criticisms of this conflict of interest were duly noted by the Panel during its country visits.

This conflict of interest was also recognized in the **Policy Mix Peer Review** implemented in Moldova in 2012 (under the "IncoNet EECA" project of the Seventh EU Framework Programme for R&D, FP7).⁹ The report considered the -recent at that time- establishment of Agencies under the ASM as insufficient, and recommended "to delegate policy implementation in terms of funding allocation for RTDI to an independent agency".

Figure 2: Organogram of the Moldovan Research and Innovation System



Source: Spiesberger/Cuciureanu (2015) Horizon 2020 Policy Support Facility Background Report for the Peer Review of Moldova: Research and Innovation in the Republic of Moldova

It is a complex organogram whereby, besides ASM, several Ministries are directly involved in the management of research and innovation policy and/ or funding:

- The **Ministry of Finance**, that defines the allocation of government resources for R&I.

9. <http://www.inco-eap.net/en/99.php>.

- The **Ministry of Economy**, that deals with innovation and technology transfer in the business sector.
- The **Ministry of Environment**, that allocates moderate R&D funding through its National Environmental Fund (FEN).
- The **Ministry of Health**, that disposes of several subordinated health research institutions.
- The **Ministry of Education**, that oversees the higher education sector in order to strengthen the research capacities at universities.

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.

ASM and its subordinated bodies are the main players for policy implementation, notably through:

- A **Center for Fundamental and Applied Research Funding (CFCFA)** within ASM, established in 2012 for the allocation of public funding for fundamental and applied research and which manages the main Moldovan funding programs.
- The **Moldovan Agency for Innovation and Technology Transfer (AITT)**, another funding agency under the ASM, responsible for support of innovation and technology transfer.

In addition, the Ministry of Economy established an agency for SME support, the **Organisation for SME sector development (ODIMM)**.

The **National Council for Accreditation and Attestation (CNAA)** accredits research organizations in Moldova. This is highly relevant for institutions wanting to become eligible for public R&I funding. These have to undergo an evaluation and accreditation procedure, conducted by the CNAA. Accreditation is granted for a period of up to five years. Under the Code on Science and Innovation all research organizations accredited by the CNAA become members of the Academy of Sciences. They are categorized into three different types: institutional, profile, and affiliated members of ASM.¹⁰ In 2010-2014, most organizations have undergone their second evaluation and accreditation procedure, since accreditation was introduced in Moldova.

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)**, managing dedicated research funding under the Ministry of Environment.

Local authorities have some rights in R&I 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&I development.

A great **difference can be observed in the R&I capacity between the capital Chisinau, and the rest of the country's territory**. Chisinau is inhabited by 21% of the country's population and generates approximately 50% of the GDP. Among the 60 organizations accredited in the years 2005-2013 by the CNAA to carry out research and development activities, only three were situated outside Chisinau.¹¹

3.2 Financing of R&I

In terms of **public funding for R&I**, Moldova's lowest point was reached in 2001 with 0.21% of GDP. Only as of 2004, with the reform of the R&I system, a significant increase in overall R&D intensity can be observed. The public financing of the R&I system increased up to 0.55% of GDP in 2007 (see Figure 3 below).¹² However, in this year with the outbreak of the financial crisis a turning point was marked and since then the funding is in a steady decrease.¹³ **The Gross**

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

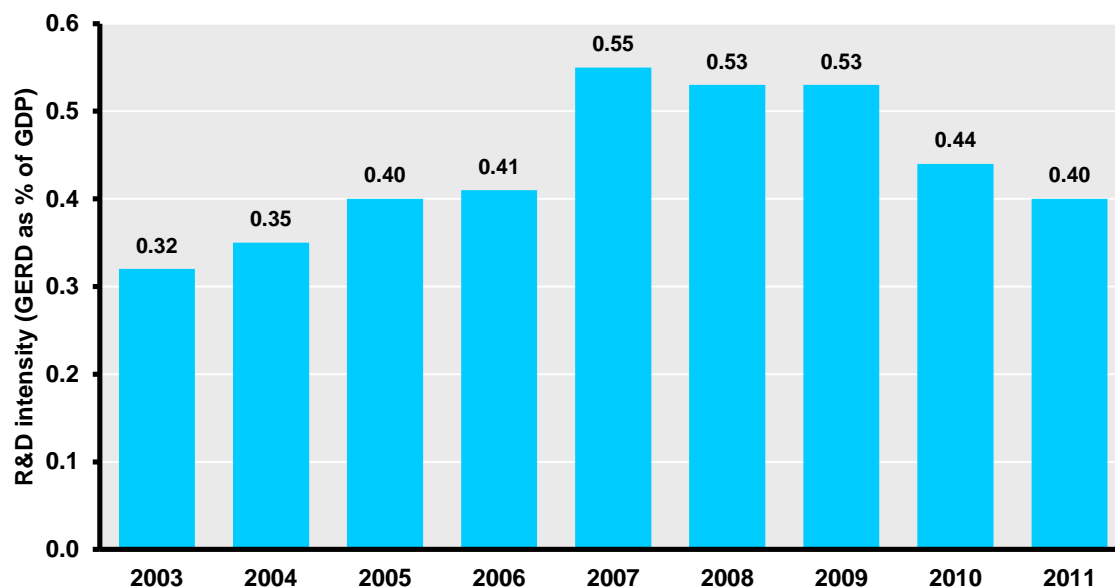
11. CNAA, 2015, www.cnaa.md.

12. According to data of the ASM the peak was reached in 2008 with 0.63% of GDP.

13. For data, see National R&D Strategy (2014), article 10.

Domestic Expenditure on R&D (GERD) as share of GDP declined to 0.4% in 2011. For 2014, ASM reported data indicate that the share of GDP further dropped to a moderate 0.35%.¹⁴

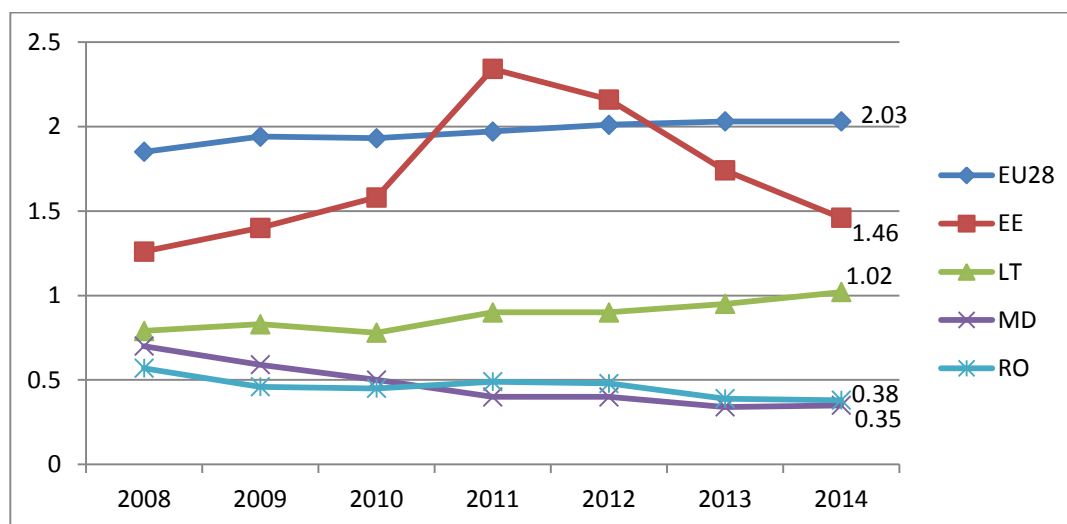
Figure 3: Republic of Moldova - R&D intensity, 2003-2011



Source: DG Research and Innovation - Unit for the Analysis and Monitoring of National Research Policies
Data: UNESCO Institute of Statistics (UIS), 2015

The R&D spending *per capita* is, with about €6.6, also extremely low, more than 80 times lower compared to the EU average, and more than 4 times lower than in the neighboring Romania.¹⁵ **Such a low level of financing goes against the R&D intensity national target set by Moldova to reach 1% of GDP by 2020 and leads to a *marginalization* of R&I capacity building and its potential to contribute to economic growth in the country.**

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



Data: EUROSTAT, UNESCO UIS, ASM and SCSTD Source: Spiesberger/Cuciureanu (2015) Horizon 2020 Policy Support Facility Background Report for the Peer Review of Moldova: R & I in the Republic of Moldova

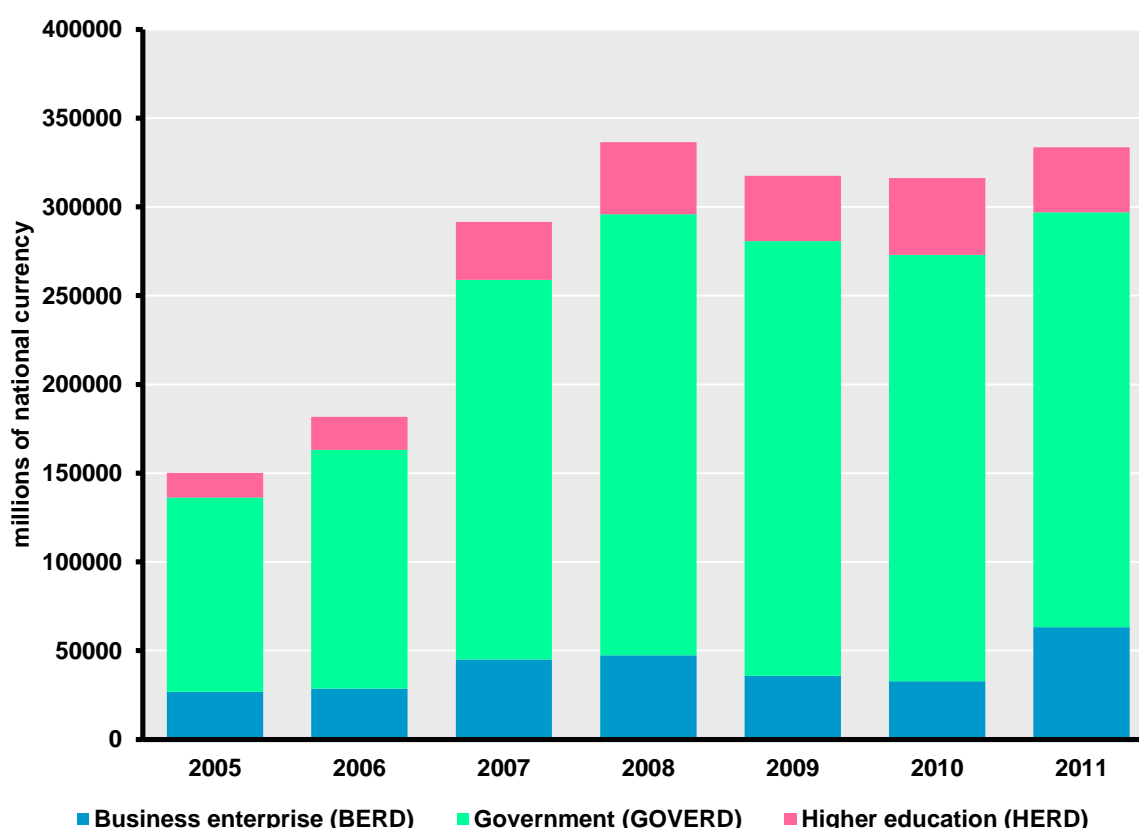
14. Supreme Council for Science and Technological Development of ASM (SCSTD, 2015).

15. See EUROSTAT (2016) database: <http://ec.europa.eu/eurostat/data/database>, and SCSTD, 2015. The figures would be a bit less dramatic, if expressed in Purchasing Power Parities (PPP).

It should be noted that in addition to the **limited intensity of the R&I effort**, research expenditure in *absolute values* is also very low. It amounted to Moldovan Lei 425.5 million (**€ 23 million**) in 2014. When considering that several R&I related expenses such as infrastructure and consumables are mostly imported, the scarcity of the research funds is becoming even more critical. **The Panel considers this scarcity of R&I funding being among the most serious problems in the Moldovan research system.**

In parallel, the sectors of performance of GERD are highly *unbalanced* with a **predominant R&D expenditure performed by the government** (ca. 70% in 2013) while about 10% is performed by the Higher Education sector and only 20% by businesses.¹⁶ The private non-profit sector is insignificant in R&D performance. A similar situation can be observed when looking at the sources of R&D funding. Based on the available information and on interviews carried out by the panel, it is estimated that it is largely the government that finances R&D in Moldova. However, no exact figures of GERD by sources of funding could be traced, as data by business sector are not collected.

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



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

Under the current circumstances and despite the severe economic constraints, increasing R&I expenditure appears as a capital necessity for Moldova. It should be considered as a national investment which directly contributes to sustainable growth and to addressing key societal challenges for the country, through building and preserving scientific and technological capacity and expertise. **Such increase should of course be accompanied by the necessary reforms to ensure the quality and the performance of the national R&I system of Moldova.** Those necessary reforms are addressed in the subsequent chapters and operational recommendations proposed in this report.

However such an increase is currently absent from the political agenda: according to several interlocutors from the governmental and parliamentary side, **the goal of 1% of GDP for R&I in 2020 seems abandoned** and "no (funding) increase is foreseen for the next 3 years". Even a

16. See UNESCO Institute of Statistics (2016): <http://data.uis.unesco.org/Index.aspx> Data for 2013.

reduction can be envisaged ("a reduction will *maybe* not be necessary"). According to the panel, such a development would be catastrophic, notably if reforms are envisaged, as those will require additional investment to maximize the impact of their successful implementation.

3.3 The R&D human resource base of Moldova

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, 2015a). This strong decline is largely due to the very low funding of the R&I system over the past 25 years, and to the poor conditions in terms of careers and salaries of national researchers. This has been partly responsible for a large brain drain both towards third countries 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 million of inhabitants is more than 4.5 times lower than in the EU**. This gap is likely to widen, given the combined trends of emigration of talented young researchers and the low attractiveness of scientific careers in Moldova.

Since 2004, the Academy of Sciences has set itself the goal to promote and enact policies to reduce **brain drain and to consolidate the infrastructure of research organizations and major universities**. The major focus areas of the Academy's work in this respect, as stated in the interviews carried out by the panel are the consolidation of the scientific community and the development of qualified skills to better ensure success in national and international R&D projects. At the national level, the goal of the Academy is to reinforce the country's science base. At the international level, the main objective of these actions is to foster better integration into the European Research Area.

3.4 Internationalization of R&I

In 2014, major progress was achieved in **Moldova's rapprochement to the EU**. Milestones included the *EU-Moldova Association Agreement*, establishing a Deep and Comprehensive Free Trade Area (DCFTA) and the Visa-free travel to the EU granted to Moldovan citizens.

In the field of R&I Moldova became **Associated to the EU's Horizon 2020 (H2020) programme**. As of 1 July 2014, Moldova, along with the Western Balkans countries, signed up to Horizon 2020.¹⁷ Up until March 2016, researchers from Moldova have participated in **130 project H2020 proposals**, of which 15 were awarded with a contribution from the EU of € 1.94 million.¹⁸ Considering the limited number of researchers and the **limited intensity of the research effort in the country**, this performance puts Moldova in a leading position among the Eastern Partnership countries as concerns H2020 participation.

It needs to be noted that Moldova was already associated to the EU's FP7 program and was herewith the first associated country among the New Independent States of the Former Soviet Union. The merit of this far-sighted and far-reaching decision, undertaken by ASM at the time, needs to be underscored. It allowed Moldova a first experience of integration in EU policies. Moldovan representatives have since then been participating in the Framework Programme committees for both FP7 and for H2020. Moreover, a **Moldovan Office for Science and Technology** (MOST) was established in Brussels in 2012. In FP7 Moldova participated in 58 projects with an EU contribution of € 4.15 million.¹⁹

ASM has in general supported the internationalization of Moldovan science not only towards the EU but also with other partner countries. Several bilateral funding schemes have been established with e.g. Romania and Russia. ASM also established cooperation through 41 agreements with international research and research-funding entities, the majority of which located in the European Research Area. The Academy enabled as well participation of Moldova in EU activities on the better coordination of national R&I programs, including ERA-NETs and JPIs (e.g. WaterWorks).²⁰

17. http://europa.eu/rapid/press-release_IP-14-746_en.htm

18. Data provided by ASM, 2016.

19. Raport de activitate al Centrului Proiecte Internaționale al Academiei de Științe a Moldovei pentru anul 2014, http://cpi.asm.md/wp-content/uploads/2012/08/2014-CPI-RAPORT_Final-Jan-25.pdf.

20. For more information on the internationalization of Moldovan R&I, see the website of the ASM Center for International Projects: <http://cpi.asm.md/> and the H2020 website of Moldova: <http://www.h2020.md/>.

Several critical systemic issues need to be addressed to deepen the political association and economic integration with the EU. These concern notably the need for an improved governance of the R&I system, solidly combating corruption, a stronger public administration, an independent judiciary system and strengthening the rule of law.

To **fully exploit the potential of association** with the EU (and in particular with ERA), both for the economic and social development of Moldova, there is a clear demand²¹ to “*prioritise reforms aimed at addressing the politicization of state institutions, systemic corruption, public administration reform aimed inter alia at enhancing the effectiveness of regulatory bodies, transparency and accountability in the management of public finances as well as with regard to policy making*”. Moving forward in these areas is a prerequisite to create the right environment for the reform of the R&I system of Moldova, something which is widely recognized and awaited by national stakeholders including researchers, academicians, NGOs and entrepreneurs.

To summarize: not all is bleak. The national R&I system has succeeded in **preserving a certain research capacity under very difficult conditions**. Notably the ASM managed to play a relevant role in achieving an increase in R&I funding from 2004 onwards and in the Association of Moldova to FP7 and H2020. Positive participation trends were observed in these EU R&I funding programs in spite of the country's meager investments in R&I and its sluggish reform pace.²² In addition, and also despite the complex environment, some Moldovan research institutes achieved an international scientific record in their research areas, including the *Institute of Applied Physics*, the *Institute of Electronic Engineering and Nanotechnologies*, and the *Institute of Chemistry*.

A modern systemic approach to R&I policy requires the implementation of a **broad portfolio of reform measures** aimed at creating a favorable environment for public and private R&I activity in Moldova. The cumulative effect of implementing these measures, which are outlined and suggested in the following chapters of the report will certainly contribute to increasing the role of R&I as a key capacity-building and growth-driven policy in Moldova.

The Panel's recommendations should not be read as a menu but as a road map for the continued improvement of the Moldovan R&I system. However, the experts cannot decide on the actual implementation (or not) of reforms. It thus remains an exclusive responsibility of the Moldovan authorities to make the best possible use of the Report. It should be used as a "compass" for future reforms, with the Government deciding on the best possible route. R&I is a small but important policy area. Without strong commitment to reform of the state institutions and of the public administration, an isolated reform of the R&I subsystem will fail. And **applying just a cosmetic reform might even be a deadly cure for the Moldovan R&I system**.

In that respect, the PSF Panel considers **that the present situation constitutes a bottom-line which by no means should be further downgraded in terms of funding, reforms and the human resource capacity for R&I.**

The Panel believes that **a smart increase in the national investment in R&I is necessary, in parallel with long-awaited reforms in the structure, governance and functioning of the R&I system.** This will help reaching the national societal and economic goals of the country and facilitate a better integration of Moldova in the European Research Area. In addition it will improve Moldova's knowledge-base and establish closer links between the science and the business sectors leading to a higher creation of economic added value from the country's scientific capacity.

The recommendations of the Panel aim to contribute to **strengthening the Moldovan R&I system, i.e. addressing its weaknesses, building on current strengths and optimizing the impact of the funds to be allocated**, based on expertise and good practice in the EU.

21. See the Council of the European Union conclusions on the Republic of Moldova of 15 February 2016: <http://www.consilium.europa.eu/en/press/press-releases/2016/02/15-fac-moldova-conclusions/>.

22. Moldova shows higher participation rates in H2020 and higher funding than countries with a similar history as part of the Former Soviet bloc such as Armenia or Georgia. See for data e.g. the Austrian Website for EU-performance monitoring, based on the EU's E-CORDA data system (in German): <https://eu-pm.ffg.at/ui/login>.

4 INCREASING THE IMPACT OF R&I INVESTMENTS

Increasing the impact of R&I investments requires **ambitious reforms of the Moldovan R&I system that lead to strong improvements in its key pillars, i.e. governance, funding, human resources and innovation capacity.**

In this chapter are brought together the analyses and recommendations of the panel around this area. The overarching issue of governance, as well as priority-setting and the relevance of improving Moldova's R&I statistics in order to support better policy-making for R&I are discussed.

The remaining focus areas of the review (financing, human resources, innovation) are discussed in the forthcoming chapters.

4.1 Better embed R&I in the economic strategy of Moldova

R&I needs to be better linked with the socio-economic developments of the country and better embedded in Moldovan policies aiming at those developments. Several strategic policy documents dealing with R&I are available in the country. All of them recognize the role of R&I as a leading factor for the country's socio-economic development.²³

Those include notably:

- The overarching National Development Strategy 2020 (2012), covering all policy areas and not just R&I
- The National R&D Strategy (2014)
- The Innovation Strategy (2013)
- The SME Strategy 2012-2020 (2012)

The **overarching National Development Strategy 2020** was approved by *Law Nr. 166 of 11 July 2012*. It states that:

"A change in the development paradigm can only occur through a concerted effort by both Government and society. This effort is meant to identify, as quickly as possible, and address those gaps that still impede an economic development model focused on raising investments in fixed capital and its increased utilization, including by increasing labor force productivity.

As a way to increase the productive stock of capital and the knowledge regarding its use, the economic development paradigm would imply attracting investment, developing export industries, ***promoting a knowledge-based society, including through strengthening research and development activities, innovations and technological transfer geared towards efficiency and competitiveness.***"

As regards the R&I strategies:

- The **Innovation Strategy for 2013-2020: Innovations for Competitiveness**, developed by the Ministry of Economy and approved in September 2013 foresees five goals: adoption of an "open governance model" for R&I; enabling people to acquire innovation skills through entrepreneurship training; orienting companies towards innovation; using knowledge to solve societal and global challenges; stimulating demand for innovative products and services.
- The **National R&D Strategy of 2014**, developed by the ASM and approved by the Government reflects a consensus among R&I stakeholders around five main objectives: capacity building, focused priorities, stronger links within the system, internationalization, and governance. An Action Plan is annexed to the strategy, but it appears to lack the necessary financial resources for its roll out. Moreover, **the role of research-performing universities is insufficiently addressed by the Strategy and the Plan.**

In both legal texts, **the thematic priorities for R&I are not clearly identified.** For example, the R&D Strategy mentions six broad societal challenges from H2020 as priorities. In this context, the Moldovan Parliament approved in June 2013 five strategic directions of R&I from 2013 to

23 However, research is only weakly mentioned in the context of the reform of the higher education system.

2020.²⁴ However, the formulated "thematic priorities" only weakly correspond to the overarching National Development Strategy. This hinders its practical implementation through competitive calls.

In sum: **although there is a rich collection of strategic documents, these show very weak coordination and lack clear links and synergies.** The documents appear as "visions" of policy-makers and are subject to stakeholder influence in securing different interests. They seem to have benefitted only to a very limited extent from interaction with society, beyond direct R&I stakeholders.

There is therefore a **need for critical review of all existing strategic documents**, and notably the R&D and Innovation strategies, **to create an integrated, coherent and aligned set of priorities** and implementation measures. Because of the limited resources available, there is a clear need to ensure the most effective use of available budgets for R&I. SMART goals should be defined with clear-cut implementation and transparent monitoring mechanisms in place.

It is also most relevant to go beyond strategic "vision" thinking and to move towards a sound and measureable implementation of the strategies and their backing up plans. Thematic priorities should be aligned with national socio-economic needs. Strong participation of stakeholders, in particular entrepreneurs, researchers and civil society representatives, in priority-setting, is critical to build trust in the governmental strategies.

Recommendation 1: Better embed R&I policy in the overall economic policy strategy, improve synergies between the R&I strategies, and reinforce priority-setting with increased involvement of R&I stakeholders

Sound R&I policy must support Moldova's strategy for socio-economic development. There is therefore a need for a critical review of all existing strategic documents addressing R&I policy in order to create an integrated, coherent and aligned set of priorities and implementation measures. SMART goals should be defined, with a clear implementation pathway and a transparent system to monitor developments. The country should nurture a structured and sustained dialogue with stakeholders to reinforce their trust in a coherent set of R&I policy strategies.

4.2 Strengthen the public perception of the role of R&I

The panel findings indicate that **the public perception of the role of R&I as a contributor to the socio-economic development of Moldova is rather low.** This remains an important challenge to be addressed. So far limited efforts were undertaken by the public authorities to highlight the benefits that moving towards a knowledge society brings about for Moldova's economic growth, competitiveness and social cohesion.

The **participation of civil society representatives in the developments linked to the R&I system of the country is so far very limited.** It is nonetheless crucial to secure support to underpin the national efforts to reform the R&I system. Engaging stakeholders in structured dialogues with policy-makers that facilitate their first-hand and transparent access to information on R&I policy developments, improving the way that stakeholders participate in the policy definition process through much more frequent public consultations on R&I matters, investing in science popularization initiatives (especially towards the young generation) building on successful recent initiatives (see Case study 1 below on the Science SLAMS) or incentivizing scientific careers throughout the education system, will all support an increased positive public perception of R&I as a driving force of the socio-economic upgrade of the country. At the same time, a coordinated set of measures in this respect will also improve societal trust in the R&I system and in its capacity to generate economic development and increased quality of life.

24. 1) Materials, technologies and innovative products; 2) Energy efficiency and use of renewable energy; 3) Health care and biomedicine; 4) Biotechnology; and 5) National heritage and development of the society.

Case study 1: The "Science SLAM"

The popularization of science in Moldova gained a certain traction recently with the organization of the **Science SLAMs**, which started in May 2014. The SLAMs are an initiative fostered by the *DAS foundation*,²⁵ linked to the IT company DAS Solutions, in partnership with ASM and media partners. The mission of SLAMs is „to increase the level of public awareness and interest regarding research and innovation, ensuring this way a sustainable development of society”.

The general concept is to run an "intellectual and funny battle" in a public context, whereby Moldovan innovators and researchers present in an attractive way to the public their research outcomes, while they open up opportunities to engage in a dialogue around the state of the art in a given scientific field. Through successive rounds, similar to a tennis Grand Slam, each year a final is organized among the four best performers. 20 researchers (90% of them young researchers) have taken place so far in the contest. The SLAMs were attended by more than 1200 persons, and became a national event.

Public consultations on R&I policy matters for the development of national strategies have proven a most useful tool for EU and national R&I policy-making over the course of the past decade. Such public consultations facilitate awareness raising and public ownership of governmental initiatives. Moreover, they involve the broad public into R&I issues. Although such consultations have been used in Moldova already, **a much more focused and structured use of public consultations should be encouraged, with increased possibilities for stakeholder participation and dialogue.** See Case study 2 below on the Dutch National Research Agenda.

Case study 2: The Dutch National Research Agenda

The Dutch National Research Agenda²⁶ aims to realize a **better connection between research and societal and economic opportunities and needs**. It served to set priorities for academic research in the coming years, including on issues such as popularization of science, promotion of creativity, innovativeness and culture of entrepreneurship between science, society and education. The agenda shows in which topics Dutch research excels and distinguishes itself or aspires to do so. At an international level it ties with the EU R&I funding programme Horizon 2020.

It connects existing agendas and **brings different parties from Dutch society together for R&I "programming"**. It influences principal agreements, an increased dynamism of the institute system, the awarding of grants and the strategic plans of partners from the Dutch Knowledge Coalition which brings together key stakeholders of the Dutch research system, such as universities, research funding and performing organizations, and business organizations.

Until 1 May 2015 anyone in the Netherlands could submit his or her questions on academic research via the webpage wetenschapsagenda.nl. In total, individuals from academic institutions, the business community and civil society submitted more than 11.500 questions. Five academic juries, appointed by the Knowledge Coalition clustered and assessed the questions. The process was coordinated by the Netherlands' *Royal Academy of Arts and Sciences* (KNAW).

In June 2015 three conferences were held to discuss the questions which especially relevant for science development (Science for Science), the Dutch economy (Science for Competitiveness) and society (science for Society). The conferences formed the starting point for a dialogue about these questions. Knowledge institutions, companies and civil society organizations were invited discuss around specific subjects and themes emerging from these questions. The steering group of the Coalition made a final selection of questions and grouped those under a compact number. The National Research Agenda was presented at the end of 2015.

25. See for more information: <http://www.dasfoundation.md/> and <http://www.h2020.md/en/2nd-science-slam-moldova>.

26. See: <http://www.wetenschapsagenda.nl/national-science-agenda/?lang=en>

Recommendation 2: Strengthening the public perception of the role of R&I for growth, competitiveness and social cohesion

A compact and coherent set of measures is necessary to secure better understanding of the role of R&I for the societal and economic developments of the country, as well as national support to reform the R&I system. Engaging stakeholders in structured dialogues with policy-makers, improving public consultations on R&I policy developments, making them more frequent as well as science popularization initiatives are key to improve Moldovan societal trust in the R&I system and in its capacity to generate economic development and increased quality of life.

4.3 Improving the governance of the R&I system

Achieving a better and more fit-for-purpose **governance of the R&I system** of Moldova constitutes a major focus area of this Peer Review for a number of reasons. First, because the organization and steering of R&I policy **is a critical overarching issue** affecting the four focus areas for intervention identified in the letter from the Moldovan authorities that kicked off this Peer Review (see section 2 of this report). Second, because a number of necessary modifications to the R&I governance system have already been **announced in the Government Program 2015 – 2018** and in the **National R&D Strategy 2014 – 2020**. However, many of those still have to materialize. Third, because governance issues are directly linked to the **revision of the Code of Science and Innovation** due since end of 2014. Last but not least because governance has been **recognized as a major hurdle to the system development by all stakeholders** (Presidency, Parliament, Ministries, ASM, Universities, representatives of the R&I community) interviewed by the Panel.

4.3.1 Policy making and strategy development

The main legal basis for R&I policy in Moldova is the Code on Science and Innovation of 2004, and the annual Partnership Agreement between ASM and the government. It is laid down in the Code (Article 55) and stated in the Partnership Agreements that the **government delegated its powers for the implementation of state policy in the field of science and innovation to the ASM**.

The role of ASM

This delegation however appears to go **beyond the mere ‘implementation’ of the policy**. It places the ASM in the role of both policy-maker and strategy developer for reasons rooted in the Code of Science and Innovation since:

- The Code states that ASM “is the plenipotentiary coordinator of scientific work and innovation, the highest scientific forum and the scientific consultant of the country and of the Government” (Art. 71.1 and also 72.2) and that the Partnership Agreement is “empowering the Academy of Sciences to draw up State policy in the field of science and innovation” (Art. 29.1).
- The Partnership Agreement which is the major policy document deriving from the Code is concluded between the ASM and the Government, without references to specific Ministries and at the initiative of the ASM.

When considering the aforementioned facts, it appears that *de facto* the **ASM fulfills the role of a Ministry of Science**, with its President being “member of the government *ex officio*” (Art.82.2.a). The Government has thus a limited role in R&I policy: it approves the Partnership Agreement with ASM and the associated budget.

The panel acknowledges the role ASM played over the last decades as a major player in the Moldovan R&I landscape. Its distance from political influence allowed ASM to preserve its own research capacity and that of the country. It also appears to have permitted a significant increase in R&I funding from 2004 to 2008, although with fragile funding stability in the ensuing years.

Drawbacks of the current system

However, the Panel believes, as also learned from the structured set of meetings with key stakeholders and notably with the different line Ministries, that **the current governance**

structure has a number of clear drawbacks as it concentrates research policy-making, implementation and performance within the ASM. This:

- (i) **Does not contribute to a coherent science policy well embedded with the national overarching economic development strategy of Moldova**, maintaining a "disconnect" with the National Development Strategy "Moldova 2020" but also with other policies that address climate change, health threats and further societal challenges.
- (ii) **Places universities in a very unfavorable position as regards research activities**. In EU Member States, universities and research institutes constitute key research pillars. Public policy devotes particular efforts to remove obstacles to the development of their research capacities, avoiding dual systems with concentration of teaching in universities and research in the academies. The university pillar has so far been clearly ignored in Moldova. The Code of Science and Innovation emphasizes that the "state policy in the field of science and innovation is carried out by the scientific community in the Academy of Science" (Art. 55.6).
- (iii) **Does not contribute to a positive public perception of the role and importance of R&I for economic growth and societal improvement at large**. This has been often perceived by the Panel in exchanges with governmental officials and civil society representatives. It partially explains the lack of public pressure in favor of R&I funding and it can certainly call off any attempts to increase national investments in R&I in relation to investments in other national policy areas where public perception is clearly more positive.
- (iv) **Does not permit a healthy and effective policy mix**. Several other Ministries (Finance, Economy, Agriculture and Food Industry, Environment, Health and Education) in fact *claim a role* in R&I. **This can become a positive development as soon as a coherent and coordinated approach to R&I governance is in place. However, it is not yet the case**, especially when taking into account that some Ministries manage their own R&D funds (Environment) or are planning doing so (Health and Education). The "How, where and when" for coordination among the Ministries in terms of policy-making and strategy development is a crucial issue that remains to be addressed. Moreover, in a country with limited financial resources setting up parallel funding schemes does not contribute to the socio-economic impact of R&I investments, neither to the transparency of the system. It rather increases administrative burden and cost in an already underfinanced system.

Several weaknesses emanating of this governance structure were already outlined in the **National R&D strategy of 2014**, which includes in Articles 34 and 35 a SWOT analysis of the R&I system, and points out openly to critical issues to be addressed. These include for example a necessary **upgrade of the governance system**, a **revision of the concentration of functions** related to policy definition, funding and evaluation of research; the low competition in **funding**, also because the business sector is not admitted freely to public research funding schemes; deficient research funding mechanisms, in particular **institutional funding, which is not reliant on performance** but rather on remuneration of staff and overheads.²⁷ These issues will be dealt with in later chapters of this report and addressed with operational recommendations.

It is widely recognized (Ministries, Parliament, Universities, other stakeholders and, importantly, ASM itself) **that the current situation needs to evolve** in order to (i) better serve the National Development Strategy "Moldova 2020" through increased coherence of the R&I policy as part of the policy mix, i.e. with other sectoral policies (e.g. Education, Innovation, Environment, Health), and (ii) to optimize the current R&I structure in a country marked by the dominating role of ASM. This should all contribute to **building a more integrated and efficient R&I system**.

A new Agency for R&I implementation?

In that respect, the panel underlines that the '**draft Law on the modification and completion of the Code of Science and Innovation**' proposed by ASM, includes the **creation of a National Agency for Research and Innovation (ANCI)** as a "central administrative authority, responsible for the development and implementation of policies in the field of research, development and innovation, distribution of budgetary allocations for the research, development and innovation projects". This proposal has the merit to involve in the governance of the Agency various stakeholders such as representatives of universities and in particular line Ministries, a significant step forward for a better integration of R&I policy with other national policies.

27. See National R&D Strategy (2014), Article 35, Point 10.

The Ministry of Education and the Ministry of Economy on their side propose the establishment of an Agency, the **National Agency for Research and Development, Innovation and Technological Transfer (ANCDITT)** dedicated to "R&I policy *implementation*" with three departments/responsibilities: R&D; ITT and the evaluation of institutions active in R&I and accreditation of scientific personnel.

In the two proposals, but also in the discussions with stakeholders, it became clear to the panel that the **responsibility for R&I policy-making and especially for strategy development does not seem to attract the necessary attention**. Even if the ASM in its proposal foresees the development by ANCI of "the *National Research and Development Programme*, which will become the main instrument for promoting the state policy in the field" there is no mention of the *responsibility* for such state policy.

Public Research Organizations (PROs), and in particular the Academies of Sciences have been traditionally key research performers, and partly also research funders and policy makers in Eastern European and Former Soviet Union countries. Since the dissolution of the Soviet Union, these PROs have experienced a significant transformation of their role. **Case studies 3 and 4 below highlight the experience of the Baltic states**, where PROs merged with universities, were dismantled, or continued in a downsized and revamped form. They also cover the examples of Poland, Russia, and Austria, in relation to the role of the Science Academies as PROs. Different models and roles of PROs (including Academies) are common, and countries should strive for the optimal solution against the circumstances of their particular systems. However, **Academies do normally not fulfill the role of Ministries or major funding agencies**.

Case study 3: The experience of Baltic states²⁸

The collapse of the Soviet Union in the early 1990s and the ensuing integration process of Baltic states into the EU led to massive structural changes in their R&I landscape. This **transformation took a much more radical change path than in any other Central and Eastern European Countries (CEEC)**. There are several specific features of that transformation, which are common for the Baltic States:

- 1) The need for transformation from being a part of an R&D superpower towards the **demands and possibilities of small independent national states** with limited natural and human resources.
- 2) The speed and depth of the re-structuring of the R&D financing and management systems. Initiated by scientists themselves, who united into unions of scientists even before the end of the Soviet Union, the **administrative functions of the former 'central' bodies of academies of sciences were abandoned**.
- 3) The collapse of the network of academy of sciences institutions, distinguishing them from the CIS and CEEC where the academies of sciences, uniting complex networks of research institutions, survived. This cardinal change prepared the ground in the Baltic States for a **return to the traditional university-centered R&D system by integration of research institutes into universities**.
- 4) Most decisions on **institutional restructuring and on changing R&D financing** in the three Baltic countries, and on setting research priorities, have been **based on international and national evaluation** of science as a whole, research institutions, and science management structures. The necessity of regular evaluation of science for boosting high quality research was understood at the very beginning of transformation, and this all-encompassing regular practice has been adopted.

In spite of similarities, each Baltic country chose a different course: a more thoughtful approach to the reform in Estonia, a more radical reform in Latvia, and a gradual and gentle reform in Lithuania.

In **Estonia**, 23 Soviet-era sectoral R&D institutes, mostly subordinated to different ministries, were closed except five in agriculture and two in energy. Research institutes of the Academy of Sciences (17) were merged with four universities. Estonia's achievements in the first phase of the reform of its R&D system in the 1990s up to the EU integration in 2004 in comparison with the other two Baltic countries were: the rapid re-orientation to collaboration with researchers and research organizations in Western Europe; the success in receiving grants in EU funding programs; the rapid development of information technologies; the periodical assessments of research fields and institutions by foreign experts; the involvement of foreign peers in peer-review; financing of R&D activities fully based on scientific merit; intensive publishing in SCI, SSCI, and A&HCI-journals; rapid technology transformation through foreign direct investments.

In **Latvia**, most of the Soviet-era R&D branch organizations were closed or left without core funding. The small Latvian industry was not able to fund industrial, applied research and sustain institutes, which were previously part of big Soviet industrial conglomerates. Academic state research institutes were not integrated into the

28. See for example: Kristapsons, J., Martinson, H. and Dageyte, I. (2004). *Baltic R&D Systems in Transition: Experiences and Future Prospects*, Riga: Zinatne. http://www.lza.lv/csts/Baltic_R&D_Systems.pdf.

Martinson, H., and T. Raim (2001). "Strategic Approach versus Spontaneity in Restructuring the R&D System in a Small Country." *Government Laboratories – Transition and Transformation*. NATO Science Series 4: Science and Technology Policy – Vol.34.

university system and remained or became national research centers (centers of excellence). The most significant accomplishments of Latvia in the first reform phase were: decisive switching to project financing in 1990, depriving research institutions of basic state funding (quick introduction of grant system for Latvian scientists with standard EU-like financing principles); the rapid re-orientation to collaboration with researchers and research organizations in Western countries; support for market-oriented research from state science budget (in the last 10 years these allocations amounted to about 10%); systematic work to bring together not only domestic but also scientists of Latvian origin around the world (election to the Latvian Academy of Sciences, organization of the world congresses of Latvian scientists).

In **Lithuania**, 29 of former Soviet research institutions got transformed into state research institutes. 13 were renamed and became departmental scientific institutes, which received project-based funding from different ministries, while 6 became part of higher education institutions. Others were retained as state institutes, but without core funding. The strong points of the first RDI reform phase were: assimilating the experience of the international scientific community in science governance, financing, and evaluation; developing co-operation with foreign researchers and institutions; intensification of publishing in SCI-journals and large-scale publishing of scientific literature in Lithuania; development of the network of state universities and research institutes; founding of higher education institutions in periphery towns; creation of centers of excellence including those supported by the EU; a growth trend in the number of doctoral dissertations.

After joining the EU the R&I systems of Baltic countries developed in a more evolutionary way. This recent phase of reforms follows a similar path in all EU Member States of the CEE region. **Reform processes were strongly stimulated by EU level R&D policies**, first under the Lisbon Strategy, second benefitting from the EU Framework Programmes for R&I as the driving force of change, and third by the introduction and implementation of the European Research Area (ERA). An important factor in the "Europeanization" of R&D policies in new EU Member States was as well the use of Structural Funds.

Case study 4: The Academies of Sciences of Russia, Poland and Austria

The Russian Academy of Sciences (RAS):²⁹ RAS was historically the most important Russian research organization, and a stronghold of the country's basic research. It absorbed around one third of Russian civilian R&D budget or more than RUB50b (more than €1.5b) per year. For several years efforts were undertaken to reform the academy, for example by improving the accountability towards the government through annual reporting and output measurement. It was however with a new law of September 2013 that substantial changes to RAS were initiated in practice and that its autonomy was cut back. A Federal Agency for Scientific Organizations (FASO) has taken over the management of the RAS institutes, including the management of their property and the appointment of their directors. This reorganization has had significant repercussions on the number of collaborators and budget. While in 2013 the Academy's research personnel amounted still to about 130,000, it was halved to about 65,000 (or about 9% of the total Russian R&D personnel) in 2014 as a result of the reorganization. The other half falls now under the direct management of FASO.

The Polish Academy of Sciences (PAS):³⁰ PAS is one of the most relevant scientific institutions in Poland. It has an autonomous status and is supervised by the Prime Minister, with the exemption of financial supervision under the Ministry of Science. In its history, PAS neither fulfilled the role of a public policy-maker (Ministry) nor that of a funding agency. Its tasks include organizing and conducting research in all fields of science, and providing scientific advice and evaluation for state institutions. PAS conducts doctoral and postgraduate studies and other educational activities. Research and education were traditionally interlinked in Poland and not separated, as this was usual in Former Soviet Union countries. About 2/3 of research activity was performed at universities even under the communist regime. In 1989, after the change of the political and economic system, PAS disposed of about 6% of the total research staff in Poland, which as a result of restructuring declined to about 4% (about 3,500 researchers) in 2014. The Polish research system was relatively weakly influenced by the dramatic changes of the political and economic system in 1989 and the ensuing transition phase. This is now more and more recognized as one of the important reasons for the currently weak position of Polish science in Europe. Structural changes were mostly introduced to the system because of financial limits.

The Austrian Academy of Sciences (OeAW):³¹ OeAW is one of Austria's central non-university research and science institutions. It has about 1,450 employees dedicated to basic research and interdisciplinary exchange of knowledge. It disseminates new insights, provides advice on policy and society, and informs the general public. OeAW's activities comprise performing research financed by institutional funding and competitive funds. Additional activities are (1) the operation of fellowship programs, (2) awarding prizes to researchers in recognition of outstanding scientific achievements, (3) public talks and lectures in sciences, (4) publishing scientific work. OeAW is financed and supervised by the Austrian Federal Ministries of Science, Research and Economy. Its role in the Austrian science and research system is that of a major public research performer in basic sciences. Other major research performers (on equal terms) in basic and applied research in Austria are public and private universities, and non-university institutes in applied sciences (e.g. the Austrian Institute of Technology as Austria's central non-university institution for applied research, www.ait.ac.at).

29. See: <http://www.ras.ru/about.aspx>

30. See: <http://english.pan.pl/>

31. See: <http://www.oeaw.ac.at>

4.3.2 A ministerial responsibility for R&I policy making and strategy development?

In many EU Member States and internationally, **the responsibility for R&I policy making and strategy development is within a Ministry (or a State Secretariat), or distributed over two or more Ministries**. Often, such responsibility is combined with closely related policy fields, e.g. Education, Development, Culture, Economy, Industry.³²

Such a governance structure presents **several advantages, despite the fact that there is no one-size-fits all optimal solution**, as the best governance structure for the country under scrutiny will depend on the features of the national R&I and on the overall organization at Ministerial level. The advantages can be concentrated around four principal blocks:

1. It helps to increase the position and visibility of R&I in the portfolio of public policies by integrating R&I policy in overall governmental policy-making responsibilities;
2. It makes coordination among Ministries easier by using the -already in place- intra-governmental coordination procedures;
3. It reduces duplication of efforts and activities such as the development of parallel funding streams for R&I under different Ministerial portfolios, as reported for Moldova;
4. It contributes to improving the structure, organization and funding of R&I.

Creating a single Ministerial responsibility will also promote the **coherence of actions to be undertaken by different Ministries** (e.g. cooperation between the research and education stakeholders).

Such **coherence is not ensured by the current R&I governance system of Moldova**. In the current scheme every Line Ministry is responsible for "*Developing and implementing policy documents in ITT [Innovation and Technology Transfer]*" and "*Examining and approving the R&D and ITT projects presented by subordinated organizations*". This approach maximizes the risk of having each ministry develop its own procedure for funding allocation and therefore is highly likely to lead to increased fragmentation of the limited research resources, reducing transparency and weakening the fund allocation procedures in general.

For the specific case of Moldova, the **disadvantage of moving R&I policy-making to a Ministry (or set of Ministries) is clearly the greater vulnerability of the R&I sector to governmental changes**. These changes, although typical for democratic systems, risk exerting a negative influence on a system which aims at consolidating over time. The present governance structure, with the ASM acting *de facto* as a Ministry for R&I, had the merit to preserve to some extent the sector from too many changes due to the considerable degree of autonomy of ASM and the role of its President as an *ex officio* member of the Government.

However, to **reduce the vulnerability** of the R&I system from potentially frequent governmental changes and political short-term influence on capacity building, a number of pre-conditions appear as critical, including the need to ensure a **broader consensus to define R&I policy and funding** (see sections 4.1 and 4.2), **the creation of an independent Agency** (see section 5.1.1), and **increased and more stable funding for R&I** activities.

The **readiness -in terms of capacities and expertise- of the Ministry(ies) to run R&I policy making and strategy development** should be considered in this context. During numerous interviews, the Panel found no evidence about such readiness to undertake this responsibility. It was recognized at various instances, even at highest political level, that there is a clear lack of capacity and qualification in terms of human resources in existing Ministries.

Equally important is the **lack of vision that the Panel noted in relation to R&I policy development**. Most stakeholders welcome reforms that redress a number of weaknesses in the current system (e.g. removing conflicts of interest; increasing transparency in fund allocation) but only a few are ready to *rethink* the role of R&I and consider wide-ranging more "radical" reforms. This is becoming a critical issue since increased investments in R&I go hand in hand with structural reforms to increase the quality and the performance of national R&I systems.

The transfer of responsibility to the **Ministry(ies) can undertake** various forms:

32. For example: Ministry of Education and Research (Estonia, Germany), Ministry of Science, Research and Economy (Austria), Ministry of Education, Culture and Science (Netherlands), Ministry of Economy and Competitiveness (Spain).

- *An Implementing Agency for R&I*, which according to converging views of all stakeholders and of the Peer Review Panel, should be created;
- *The expertise of the ASM* for the management of R&I possibly through the integration of qualified human resources from ASM into the Ministry(ies);
- A wide-ranging *consultative/advisory body* involving stakeholders (researchers, university professors, private sector representatives, NGOs, the society at large, as well as foreign experts) that can be established on a permanent or ad-hoc basis (e.g. when a new multiannual plan will have to be prepared).

The **case of the Netherlands**, described as Case study 5, illustrates the functioning, distribution of responsibilities, and structure of R&I governance in the country. Governance involves Ministries, funding agencies and advisory bodies.

Case study 5: Policy making and advice for Science, Technology and Innovation in the Netherlands

Policy-making and advice for Science, Technology and Innovation in the Netherlands involves the following bodies and processes:

The Ministry of Education, Culture and Science³³ that issues policies, drafts legislation and appropriates public funds for science. The policy goals for the Ministry focus on fundamental research; strategies to promote innovation; the self-regulating powers of the scientific community; improved career opportunities for young researchers, particularly women. Within the government, this **Ministry has the largest budget for research (approximately two thirds of the total)**. An important part takes the form of institutional funding.

The Ministry's policy implementation agency is **The Netherlands Organisation for Scientific Research (NWO)**, tasked to fund scientific research at public research institutions, especially universities.

The Ministry of Economic Affairs³⁴ supports innovation and encourages science-business cooperation. It identified the following fields as promising for entrepreneurship and innovation in the Netherlands: water, food, horticulture, high tech, life sciences, chemicals, energy, logistics, creative industry and head offices.

The Advisory council for science, technology and innovation (AWTI)³⁵ is an independent body that advises the government and parliament on policy relating to scientific research, technology development and innovation and its impact on economy and society. AWTI mainly relates to the areas dominated by the Ministry of Education, Culture and Science (science policy) and Economic Affairs (innovation policy). The AWTI's 10 members come from various sectors of society, such as research institutes and the private sector. They sit on the Council in a personal capacity. It operates according to an annual work-program which in 2015 covers issues such as the relationship between education and higher education; capacity for knowledge absorption; Open science; and innovation-related strategy development.

Recommendation 3: Establish a Ministerial responsibility for R&I policy-making and strategy development

- 3.a** It will consolidate R&I as a major component of the national strategies for sustainable growth and the knowledge-based economy. The Panel considers that a single Ministry or more Ministries should undertake this responsibility and be renamed accordingly. The Ministry(ies) should be provided with sufficient resources -including human resources- to run the R&I policy-making and strategy development, and with adequate funding.
- 3.b** Substantial advice will be needed for establishing the Unit/s responsible for R&I policy within the Ministry(ies). Support from ASM, including advice and possibly the transfer of qualified human resources, as well as EU and/ or international advice will be required.
- 3.c** This move to such new Ministerial responsibility should be accompanied by the creation of an implementing Agency for R&I (see section 5.1.1). The Agency should advise the Ministry(ies) on strategy development and on the definition of thematic and funding priorities.

33. <https://www.government.nl/ministries/ministry-of-education-culture-and-science>

34. <https://www.government.nl/ministries/ministry-of-economic-affairs>

35. <http://english.awti.nl/about-us>

4.3.3 Inter-ministerial Council to coordinate R&I

In the discussions with the multiple stakeholders but also in the draft proposals for reform prepared by the government and by the ASM, **the setting up of an Inter-ministerial Council for the coordination of the R&I activities is envisaged**. Such a Council is presented with advisory only or with decision making capabilities, depending on the proposal, and it is supposed to be chaired by the Prime-Minister. Several EU countries have such Councils in place. They deal usually with expert advice to Ministries and to the government on R&I strategy and policy-making, but they also deal with R&I funding at times.

The **Panel is not convinced of the benefits of such an additional coordination body for Moldova**. Moldovan policy-makers should reflect well on the need for such a body and consider it in the context of the recommendations on the creation of a Ministerial responsibility (recommendation 3) and below on the new Agency for R&I (recommendation 7). However, the panel can see a value in this body as a transitional mechanism, with a precisely defined lifetime, on the way to a fully-fledged Ministerial responsibility combined with the Agency.

With all due qualifications, evidence from similar councils in European countries and beyond raises doubt about their effectiveness in general, and in particular in relation to coordination issues. A study of seven councils in the frame of ERAC (Edquist, 2014) showed that they have mostly advisory functions and they do not control a large budget for R&I policy. *"A general comment is that the bodies/councils are rather weak, although chaired by the Prime Minister."* Another study for the Swedish Vinnova (Schwaag-Serger et al., 2015) on 14 national R&I councils in Europe, America and Asia points to the weak performance of the councils regarding coordination of policy.³⁶ The findings indicate that the Councils have virtues but also drawbacks e.g. in addressing inherent obstacles to coordination, including decision-making and budget allocation matters. It should be noted in this context that the responsibility for R&I policy making lays with one or more Ministries for many of those existing Councils, something which is not yet the case in Moldova.

Instead of the creation of such Council, the Panel believes that coordination mechanisms among Ministries within the frame of the Council of Ministers -and among high-level officials responsible for R&I- **will be more effective** for the specific needs of the Moldovan R&I system. Coordination within the R&I Agency proposed by the Panel below will also be of utmost relevance in this context. The **Board of the Agency for R&I shall also provide in the (near) future a major forum for coordination of R&I policy**, involving a balanced group of stakeholders. All main actors, including the Ministry(ies) responsible in the future for Research and Innovation, the ASM, HEIs, line Ministries, business representatives and foreign experts should be represented in the proposed structure of the Board of the Agency for R&I. It is therefore urgent to move forward with establishing the Agency and its Board, which was foreseen in the National R&D Strategy and the annexed Action Plan already for 2015 (chapter 1, point 3).

Although R&I councils can of course have a beneficial and useful role for providing advice on R&I policy, the panel believes that in the case of Moldova such an additional coordination structure -in the form of the proposed Council- would **complicate the governance arrangements**. It would duplicate the coordinating structures, and make the responsibilities for R&I more diffuse. It is also not in relation to the limited size of the research community in the country and the low R&I budget available, making the Council seem overdone.

36. Schwaag-Serger et al. (2015): "Councils often fall short of expectations when it comes to coordination; the ambition of policy coordination is particularly tricky to achieve because the council as a mechanism does not address the inherent obstacles to coordination (decision-making, budgetary allocation etc.). There seems to be a general somewhat naïve view in innovation policy that gathering the right people around the table will result in consensus and coordinated action. Ironically, in countries where coordination is most needed – e.g. where there is most fragmentation and lack of integration among policy domains and ministries – achieving coordination through a council appears to also be much harder to achieve, as pointed out by OECD analysis which identifies "additional limitations to the co-ordinating influence of an advisory council in systems that have strong internal incentives to fragmentation".

Recommendation 4: The panel is not convinced about the added value of an inter-ministerial Council for R&I.

The panel believes that Moldovan policy-makers should reflect well on the need for such a body and consider it in the context of the panel recommendations to create a Ministerial responsibility (recommendation 3) and on the new Agency for R&I (recommendation 7). Ensuring appropriate coordination on R&I matters within the frame of the Council of Ministers and with the Board of the proposed Agency for R&I, will be sufficient. Such a Council can create additional bureaucratic burden and raise administrative costs in disproportion to the overall R&I expenditure level of the country and the size of the Moldovan R&I base. The panel can only see a value for it as a transitional arrangement, with a precisely defined lifetime, towards the creation of the proposed Ministerial responsibility and the independent Agency.

4.4 R&I priority-setting

Despite the scarcity of financial resources for R&I, Moldova can strongly benefit from a **specific effort to define a sound and narrow set of research priorities**.

In the **National R&D Strategy** very broad research priorities are presented. In Decision No. 150 of the Parliament of the Republic of Moldova of 14 June 2013, a set of thematic priorities are reported: materials, technologies and innovative products; energy efficiency and making use of renewable energy sources; health and biomedicine; biotechnology; and national heritage and the development of society.

In the **Partnership Agreement** of 2015 between the Government and the ASM (in its Chapter II, Articles 4 to 7), in addition to the above priorities “for the period 2014-2020, the following R&D priorities” are also added, creating relevant confusion: the principles for the development of national economy based on smart specialization and innovation; the relationship between the State and the citizens in the context of participatory democracy; inclusive and healthy society; increasing the efficiency of the agricultural sector and the processing industry; energy efficiency and alternative energy sources; training a competitive human capital, prone to creativity, innovation and continued training.

Defining and narrowing down research priorities constitutes a challenge in most, if not all countries. Securing an adequate amount of institutional funding to build capacity across the system (linked to qualitative and quantitative performance criteria) should be combined with an orientation of the system towards increased competitive funding around a set of compact research priorities. **Additional public investment in R&I should *not* be thinly spread without prioritization.** Increasing impact on growth will require a concentration of funds around areas for which substantial research capacity exists (according to international standards) and/or on fields with particular economic and societal interest or potential for the country.

The identification of such priority fields should be the result of a sound and objective process (e.g. through a foresight exercise) that should constitute a priority task for the independent Agency and its Board representing the major R&I stakeholders in the country. The priorities should be revised at regular intervals, in principle linked to the budgetary cycles.

Recommendation 5: Focus R&I priorities on a limited set, where Moldova's R&I strengths are fully utilized or where there is a large potential for scientific, technological and economic impact in the medium term

A process should be rapidly launched for the identification of a limited set of national R&I priorities, that should include fields where substantial research capacity currently exists and/or fields of particular national interest or scientific, technologic or economic potential.

In line with Recommendation 1, there is a clear need for a critical review of all existing strategic documents addressing R&I policy to create an integrated, coherent and aligned set of priorities. To do so, a structured and sustained dialogue with stakeholders should be nurtured in order to reinforce their trust in a coherent set of R&I policy strategies, and their ownership on these priorities.

4.5 Improving R&I statistics for evidence-based policy-making and funding

The availability of precise statistics for R&I is an issue given their importance for sound evidence-based policy making and funding allocation. Basic statistics are needed to capture the impact of R&I policy interventions. The Panel received information from the Moldovan Statistics Office that their personnel is appropriately trained and able to implement the necessary OECD/EUROSTAT methodologies to a considerable level ("80% of the Frascati Manual applied"). However, the lack of resources makes systematic and complete R&I data collection impossible.

R&I statistics are for that reason often missing, and notably for the last 2-3 years, and in some cases they are not fully reliable. For example, in terms of human resources only headcounts are provided while Full Time Equivalents (FTEs) are missing. This risks deriving a false picture of personnel employment, especially when considering the increasing involvement of universities in research activities (and of researchers from ASM in teaching). Equally, data on R&I in the business sector are only sporadic: only 16 enterprises did report R&D expenses during the latest available year (!), a figure that is certainly an underestimate of those operating in the R&D system according to the analysis by the panel.

The lack of commitment from Ministries to provide funding for statistical development, maintenance and upgrade has made the systematic collection of relevant data impossible. A **joint effort of Moldovan actors (and not just governmental departments) is urgently needed to complete the data**. The Moldovan National Bureau of Statistics should be supported in its task to complete the R&I statistics with adequate financial resources, and by the ASM with the necessary expertise in relation to R&I data, statistics and indicators. In addition, international support could be sought from the EU and its Member States to access expertise from National Statistical Offices, EUROSTAT and OECD in order to provide practical advice and help in data collection and process.

Recommendation 6: Moldovan authorities need to urgently improve their system to collect and process R&I statistics, as these are key for evidence-based policy-making and monitoring the allocation of R&I funding

Since R&I statistics are essential for evidence-based policy making in the area, there is a clear need to improve their collection and processing by making available the necessary financial resources for administrative capacity building of the national statistical office, including through appropriate training and staff exchanges with similar national statistical offices in EU MS. Funding for such activities should not be detracted from the already meagre R&I budget.

5 INCREASING THE EFFICIENCY OF R&I PERFORMING BODIES, INSTRUMENTS AND PUBLIC FUNDING

The Moldovan R&D system appears dominated by **Public Research Organizations (PROs)** and research capacities are concentrated in ASM and its subordinated institutes. Over 80% of R&D funding from the state budget is allocated to PROs. The highest share of R&D activities is conducted in applied sciences with most public R&D institutes operating in natural and life sciences. Researchers from public R&D institutes get the vast majority of patents and publish more in journals listed in the Web of Science than researchers in the higher education and business sectors.

Data from the National Bureau of Statistics show that in 2014 R&D activities were conducted in **51 public R&D organizations**.³⁷ Among these:

- **Institutes of the Academy of Sciences** (members of ASM, which report administratively and scientifically to ASM): 19 academy institutes accredited by CNAAS;
- **R&D institutes administratively subordinated to different ministries** (former branch R&D institutes): 15 organizations accredited as profile members of ASM, including 8 subordinated to the Ministry of Health and 5 to the Ministry of Agriculture. They are scientifically supervised by ASM and receive public funding also from ASM.
- Furthermore several organizations operate in the category of public **design-investigation organizations and design offices for construction works**.

The **National Higher Education System** includes 31 institutions, of which 19 state and 12 private universities. **20 universities were accredited as R&D performing institutions**, including 14 state universities as profile members, five private ones as affiliated members and the University of ASM as institutional member.

The mission of universities is primarily focusing on education and teaching, while research activities and links to business are weakly developed. It is a **policy priority of Moldova and ASM to strengthen research within universities**. Theoretically, all university teachers must carry out R&D, but usually the staff is driven by teaching duties and only a few conduct substantial research. Even so, the university sector contributes about one third of Moldovan researchers, who published in journals and about two fifths of patent applications filed.

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 relation to **business R&D**, the last data of the National Bureau of Statistics on research performers by sectors (2009) capture **8 private R&D organizations**, 4 mixed -public and private nature- R&D organizations and 1 joint venture organization. But **these figures are far from complete**, because the Bureau of Statistics does not yet systematically collect data on research performing organizations in the business enterprises as well as private non-profit sectors.

Much of the industrial R&D potential was lost during the transition years up to now. Today the **majority of R&D performing enterprises in Moldova carry out only minor R&D activities**. Those companies performing some R&D fund it predominantly from own resources, and are primarily focusing on the implementation of developments. Most of these companies are located in the capital Chisinau.

Business R&D and in particular the science – business links are addressed in Section 7.

37. National Bureau of Statistics (2016) <http://www.statistica.md/category.php?l=en&idc=116&>

5.1 Efficiency of R&I funding

The way that R&I activities are funded constitutes a parameter with major influence on the efficiency of national R&I systems. *Quantitative* (e.g. overall expenditure for R&I, benchmarking against partner countries, contribution of private sector) but also *qualitative* aspects need to be analyzed in this context, as well as the share of R&I funding allocated through competitive calls. The improvement in such parameters is a sign of the increased *efficiency of the public funding for R&I* and it is for that reason it has been explicitly mentioned as a focus area for the Policy Review of the Moldovan R&I system.

Currently **almost all the state budget allocated to R&I activities in Moldova is managed by the ASM**, through one of its sub-units, the Center for Fundamental and Applied Research Funding (CFCFA). CFCFA allocates the share of the state budget dedicated to semi-competitive (institutional) and competitive funding (calls for proposals) addressed to the whole research community in the country, i.e. Universities, ASM's research institutes, branch research institutes under other Ministries, NGOs, private sector.³⁸

The **public R&D funds are allocated in three modes**: institutional projects; competitive funding via calls; other types of block funding (e.g. for libraries, experimental stations, administrative bodies such as SCSTD and CNAA). Only research organizations accredited by CNAA have access to governmental R&D funding in Moldova. **Private companies are not accredited**, and as such they are not eligible for public R&I funding.

The largest share of the state R&D budget is allocated to operating costs of ASM's research institutes (institutional funding). That share is reported to reach "50 to 60%" or even "up to 70% with travel costs" according to some governmental interlocutors. It must be noted that the lion's share appears to be personnel costs. An independent evaluation –supported by foreign experts– of the quality and output of research institutes receiving institutional funding is highly recommendable. However, resources used for institutional funding are not to be disapproved *per se*.

Institutional projects

The main public funding instrument takes in fact the form of **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 competitive and other schemes to secure core funding of institutions and the sustainability of the country's science base. Under the current legal framework proposals are submitted to the CFCFA and 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 CNAA 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 maximal 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.

38. It needs to be noted that while the competitions are open to participation of the whole research community, NGOs and the private sector practically cannot receive public financing in these schemes, and that HEIs and non-academy institutes receive lower funding quotas than ASM institutes.

Competitive calls

The remaining **minor share of the total R&I budget is distributed through competitive calls** to R&I projects implemented by various research entities (ASM's institutes, Universities, branch institutes). This situation, in addition to the conflict of interest identified in section 3.1, cannot guarantee an efficient public R&I funding allocation, which would be **better deserved through the funding allocation by an independent Agency and through competitive means of research financing**. Establishing the independent Agency has been envisaged in the past, in slightly different formats, by both ASM and the Ministries of Education and Economy.

Truly **project-based competitive funding has been reduced in recent years** from 16.3% in 2010 to 8.4% in 2014. Competitive funding schemes include state R&D programmes, grants for young researchers, grants for procurement of equipment, international projects, innovation and technology transfer projects, grants for training and PhD fellowships, grants for editing monographs and grants for organizing scientific conferences.

Evaluations are usually performed by national experts, whereas in only few exceptional cases international experts have been used. **The over-reliance on national experts (to the detriment of international peer review evaluation practices) poses a problem** for the selection of projects, because of 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>	<i>2006</i>	<i>2007</i>	<i>2008</i>	<i>2009</i>	<i>2010</i>	<i>2011</i>	<i>2012</i>	<i>2013</i>	<i>2014</i>
State programmes for R&D	0.68	1.25	1.11	1.10	0.61	0.36	0.34	0.08	0.20
Independent projects³⁹	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)

In spite of the figures above, the **ASM reports a current level of competitive funding of "50% which could reach 80% if the overall budget increases"**. The diverging estimations between the ASM and the governmental officials are possibly due to the **unclear borders between institutional and competitive funding**. ASM considers institutional funding as competitive funding, while other stakeholders disagree with this assumption. In addition, it should be noted that competitive funding is often a way for increasing the very low salaries of permanent staff.

Such a **confusing situation and a limited accountability for the budget invested in R&I** are feeding a perception of "wasted investment" by many stakeholders interviewed by the panel. To redress that, external assessments can be used to evaluate the results and impact of R&I funding, and pertinent indicators such as funding per publication (or per patent), education of young researchers/ PhDs, international cooperation and grants, cooperation and contracts with business should be given and compared to similar ones in other countries.

A significant concern expressed to the Panel is the importance of **maintaining the assets of the ASM and ASM institutes**, such as buildings and experimental land for agricultural studies. Indeed, ASM fears that through political action, real estate interests would prevail over research interests, as was notoriously the case in other former Soviet republics.

5.1.1 An independent Agency for R&I

An Agency for R&I policy implementation subordinated to a Ministry, e.g. Ministry of Education and Research or a Ministry of Economy, Research and Innovation, which in turn will be responsible for the development of the R&I policy and strategy, is a typical pattern in many EU Member States.

In more rare cases such an Agency is **subordinated directly to the government** (e.g. to the Offices of the Prime Minister or Deputy Prime Minister). Such an Agency shall deal with R&I funding allocation and scientific policy advice to government and ministries. The need for an Agency is

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

widely recognized by the Moldovan R&I community, even if views diverge in relation to the structure and role of the Agency. Establishing it was foreseen by the National R&D Strategy for the year 2015.⁴⁰

Safeguarding the independence and autonomy of such an Agency from interventions that do not support the core interest of R&I policy (e.g. pressures by "politics" or potential beneficiaries) is of paramount importance to consolidate its role as a neutral entity that guarantees fair competition and equal opportunities in R&I funding. Such independence can and should be secured despite the direct link (or subordination) between the Agency and the supervising Ministry.

In that respect, several options exist:

- The **Director of the Agency** should possess well-defined qualifications and be selected by foreign peers for a multi-annual mandate. He/ she should be nominated by the Prime Minister. The position should be secured by law and dismissing is only possible under strict rules expressed in law. Similar procedures can apply also for Deputy Director positions. The leadership of the Agency should steer its personnel policy.
- The Agency should possess a **Governing Board** involving a broad range of R&I stakeholders (Line Ministries, ASM, Universities, business sector, and a consistent fraction of foreign experts). It will supervise the Agency's activities, strengthen its independent functioning and can constitute a buffer to harmful external interventions.
- The Agency needs to have **full responsibility and autonomy for the allocation of R&I funding**, and for the **selection process of project proposals**, where rules of transparency and quality must always prevail.

The Agency should possess **dual capabilities**, i.e. it should be able to act as an advisory body for R&I policy-making and as implementing entity for R&I evaluation and funding.

The key duties of the **Agency acting as advisory body for R&I policy making and strategy development entity** should include:

- The development of a *multiannual R&I strategy for Moldova*, with realistic goals and in line with broader national policies. Such a strategy should be developed under the guidance of the Ministry (see recommendation 3), and be the result of a structured consultation process with a large variety of stakeholders, as represented in its Board and beyond (NGOs, civil society).
- The development of a *multi-annual program*, in line with the strategy, including precise budgeted actions (research funding programs, infrastructure development, capacity building, research monitoring and evaluation).
- *Priority-setting* for R&I established through public consultations, expert workshops, dialogue with stakeholders, and more comprehensive foresight processes, to focus resources on available niches of excellence in the country, and on fields relevant for economy and society.
- To *present the aforementioned strategy and program to the government*, via the supervising Ministry/Ministries, for approval.

The key duties of the **Agency acting as Policy Implementation Entity** should include:

- *Publishing calls for R&I proposals* in the context of the R&I policy and strategy for competitive funding activities. Such calls should have a known periodicity, as part of a multi-annual plan, allowing the research community to better prepare itself for applications.
- *Evaluation of proposals*: international standards should apply for this task, involving transparency and accountability for the decisions. Since the research community in Moldova is rather small and 'each one knows each other', it is important to use external evaluators. In that respect the *diaspora* could also be used at a first instance and ultimately foreign evaluators (this will require the submission of proposals in *English*, important also for other reasons such as a better integration of Moldova in the European Research Area).
- *Project funding and monitoring*: red tape should be kept to a minimum and be adapted to the characteristics of the R&I projects. Good practice from EU countries should be adopted.

40. See Action Plan of the National R&D Strategy (2014), Chapter 1, Action 3.

Funding decisions should be taken on the basis ranked lists, established in line with the scores given by foreign evaluators. Formal funding decisions will be taken by the Board.

- The *evaluation* of PROs and Public Higher Education Institutions (HEIs) in the country shall be done in accordance with international standards (e.g. based on performance indicators, through benchmarking exercises).
- The *allocation of institutional funding* that should be linked to evaluation of the research entities and performance contracts.⁴¹

Good practice examples are provided by Case study 5, which looks at **implementing agencies in Romania, Ireland and Poland**. It illustrates the typical tasks and the structure of such agencies, and provides pointers for the set-up of the Moldovan R&I Agency.

Case study 4: Examples of funding agencies – Romania, Ireland and Poland

Romania. The Executive Agency for Higher Education, Research, Development and Innovation Funding (UEFISCDI)⁴² was set up in 2010 by merging The National Centre for Programme Management (CNMP), The Executive Agency for Higher Education and Research Funding (UEFISCSU) and the Management Agency of Scientific Research, Innovation and Technology Transfer (AMCSIT). **UEFISCDI is a public entity under the authority of the Romanian Ministry of Education and Scientific Research (MENCS)**, designed to “promote quality and leadership for higher education, research, development and innovation”.

Its main tasks include coordinating and implementing funding Programmes of the National Research, Development and Innovation Plan (PNCDI III) 2015 – 2020; providing technical support to the consultative councils of MENCS dealing with higher education, and research, development and innovation (RDI); and implementation of strategic projects financed by EU funds allocated to Romania for higher education and RDI policies.

As a funding agency, it performs all the tasks related to the **administration of competitive research funds**:

- 1) Rigorous selection process involving international peer-review evaluation.
- 2) Project proposals selected in decreasing order of their scores, taking into account the available funds.
- 3) All projects funded in competition are monitored throughout their implementation via progress reports.
- 4) Major project results are disseminated through brochures, e-books, events, newsletters, website.
- 5) Traceability, transparency and predictability of management and implementation of programs. Information on funding decision-making and how funds are earmarked available on the website.
- 6) Development of strategies and procedures for management and implementation of new programs.

UEFISCDI is a member of European associations (EARMA, EARTO), offers **support to SME’s through EUREKA, EUROSTARS and supports the participation of Romanian research organizations to the Horizon 2020 Programme**. It has strategic partnerships and cooperation agreements with several European research organizations (e.g Swiss National Science Foundation – SNSF, L’Agence Nationale de la recherche/France – ANR). It has been involved in more than 40 international projects, most of them under the ERA-NET scheme, funded in FP7 and H2020.

Through its **Structural Funds projects**, UEFISCDI made contributions to the development of public policies for higher education and R&I. It contributed to the analysis of the national innovation system, and developed policy proposals and strategic vision documents. It implemented and coordinated 5 strategic projects for higher education, which were aiming at a **qualitative reform of the Romanian higher education system** by creating a dialogue and negotiation space at higher education and research level. “Quality and Leadership” was the leader project having as main goal the development of a vision and a strategy for the Romanian higher education (until 2025), in order to create the main policies and actions for the medium and long term. This approach was complemented and sustained by 4 other projects: “Improving University Management”, “Doctorate in Universities of Excellence”, “Doctoral Studies in Romania – Organisation of the Doctoral Schools”, “National Student Enrolment Registry”.

The agency implements **forward-looking/foresight** projects for higher education, research and innovation policies. The agency is also trying to foster **gender equality**, remove barriers that generate discrimination in scientific careers and integrate a gender dimension in research.

41. For an overview of the practice of Performance Based Funding in EU Member States see: Jonkers, K., T. Zacharewicz (2015) Performance based funding: a comparative assessment of their use and nature in EU Member States, JRC Science for Policy Report, <http://publications.jrc.ec.europa.eu/repository/handle/JRC97684>

42. www.uefiscdi.gov.ro

Ireland. The Irish Research Council - IRC⁴³ was established in 2012 under the Government's Public Sector Reform Plan, as a merger of two former councils (the Irish Research Council for Humanities and Social Sciences, and the Irish Research Council for Science, Engineering and Technology. IRC is an associated agency of the Department of Education and Skills and operates under the aegis of the Higher Education Authority.

The IRC **manages a suite of inter-linked research schemes**, funding scholars at various career stages, from postgraduate study to senior research project-based awards. For early stage researchers, schemes include the Government of Ireland Postgraduate Scholarship Scheme, the Enterprise Partnership Scheme (postgraduate and postdoctoral), the Employment Based Programme, and the Government of Ireland Postdoctoral Fellowship Scheme. The Research Project Grants Scheme allows researchers and research teams to expand their activities into new research areas by way of stimulus project grants and knowledge transfer initiatives. In delivering on its mandate the Council's core value is Excellence, determined on the basis of independent peer review, in an open, objective, transparent and trusted way.

The Council operates within the government's policy framework, but is independent in its funding decisions. To best deliver for the research community and for citizens, the Council partners nationally and internationally, as appropriate, with the research community itself, government departments and agencies, enterprise and civic society. The Council **consults and engages regularly with the research community** to inform its work and the future development of its activities, recognizing the inherent diversity of that community. The Council ensures high standards in Council practices and policies through periodic review and evaluation, both internal and independent.

Poland. R&D funding agencies

The Polish system with two R&D funding agencies was created in 2010. The Agencies have a clear mission in their area of activity, which allows beneficiaries to use the services and support mechanisms without the risk of addressing the wrong body.

National Science Centre (NCN)⁴⁴ – responsible for basic research. Bottom-up calls (topics of projects defined by scientists) addressing different groups of researchers (young, experienced, wishing to develop international cooperation or doing research in interdisciplinary way). At least 20% of funds should go to young scientists. Projects are evaluated through peer review, according to ERC standards. Main beneficiaries are scientists.

National Centre for Research and Development (NCBiR)⁴⁵. Responsible for applied research and R&D based innovation. Calls are based on the National Research Program, adopted by the government as a result of a dialogue with stakeholders from business and academia. Calls can be opened for new areas i.e. sectoral programs based on a research agenda and financial contribution from business – usually 50/50 model. This approach allows supporting new, innovative ideas coming from business. Projects are evaluated by experts from business and research (Polish and international). The evaluation includes usually interviews with applicants. Main beneficiaries of NCBiR support are enterprises and consortia of entrepreneurs and researchers. Instruments target normally Technology Readiness Levels (TRL) 4-9, with the possibility to finance research in TRL 2-3 under specific circumstances.

Both agencies are supervised by the Ministry of Science and Higher Education. The Ministry is responsible for appointing the Presidents through open calls. In both cases, Agencies are equipped with supervisory boards composed of representative of research community (in case of the NCN) and representative of public administration, business and research community (in case of NCBiR). Both agencies operate within the government's policy framework, but are independent in its funding decisions.

43. See <http://www.research.ie>

44. See <https://www.ncn.gov.pl/?language=en>

45. See <http://www.ncbir.pl/en/>

Recommendation 7: Establishing an independent R&I Agency under a Ministry(ies)

- 7.a** The Panel, in line with all major stakeholders in Moldova, recognizes the need to establish an independent Agency for R&I. For the sake of clear responsibilities and efficiency, it suggests that the Agency will be subordinated to a suitable Ministry(ies) towards which it should be accountable and report to. Direct subordination to the highest instances at the government is an option, but this may lead to a less clear distribution of responsibilities among actors (government as such, Ministry and Agency).
- 7.b** The main aim of the Agency should be the *implementation* of the R&I policy and strategy of the country. Its duties will include the publication of calls for proposals for research and innovation activities in line with the national policy and within the limits of the budget for institutional and competitive funding; the evaluation of proposals with the support of foreign experts and according to internationally recognized standards of transparency and accountability; the funding and monitoring of projects. The Agency should also be in charge of the periodic evaluation of the PROs and Public HEIs, as well as of the distribution of institutional funding (e.g. against evaluation and performance contracts).
- 7.c** The Agency should also be involved in *policy making and strategy development activities*, in an advisory capacity to the Government and the Ministry(ies) responsible for R&I in the future. The duties of the Agency in that context should include: developing under the guidance of the Ministry a multiannual *R&I strategy* for the country; priority setting for R&I; the development of a multiannual *program* with precise and budgeted actions in line with the strategy; the presentation of the aforementioned documents to the government via the Ministry responsible for Research and Innovation.
- 7d** The *independent character* of the Agency should be secured through:
- The selection of its Director General by foreign experts or peers for a multiannual mandate, following an international advertisement of the position. The selected person should be appointed as Director General by the Prime-minister.
 - The setting up of a Board involving representatives of various stakeholders of the R&I sector: Ministry of Education, Economy, Line Ministries, ASM, Universities, Private sector and a consistent fraction of foreign experts as a measure of transparency and for promoting the internationalization of the Moldovan research and higher education.
 - The Agency needs to have full responsibility and autonomy for funding allocation, as well as for the selection process of proposals, where rules of transparency and quality must apply.

5.1.2 A single R&I funding entity

The Panel notes that in the 'Institutional scheme' for the R&I system proposed by the government, **line Ministries are supposed to "Examine and approve the R&D and ITT projects presented by subordinated organizations, ministries, businesses, in order to finance/implement them". Such an approach does not contribute to a coherent R&I policy**, to confidence building on the evaluation procedures and to an increased impact of the funded projects.

This is especially critical when considering the particularly low level of the available budget for competitive projects, which shall be scattered in the proposed structure. It is extremely important to **concentrate the available funds in order to reduce administrative costs and, moreover, for building capacity for their sound administration**. Concentrating the R&I funding allocation in a single entity will facilitate the access for researchers to the funding source, and reduce their administrative effort to search for support.

Recommendation 8: Need to concentrate all available R&I funding under a single R&I funding entity

Spreading the (limited) national R&I public funding through several Ministries and other entities as it is currently implemented, will reduce its impact and cannot contribute to the setting up of transparency, accountability and capacity building in sound program management and evaluation procedures.

The Panel strongly recommends channeling the public R&I funding through a new Agency for R&I as a single R&I funding entity in Moldova. This will help developing adequate procedures following international standards for allocating the institutional and the competitive part of the funds. The channeling of all available R&I funding through the Agency should start as soon as robust funding procedures are established as well as sound evaluation procedures for the PROs.

Diversifying the financing schemes at constant budget, even if some of the new schemes would be valuable, introduces a high risk of wasting funds.

5.1.3 Institutional versus competitive funding

Over the last years, and as a consequence of the overall reduction of the R&I funding, the **share of R&I institutional funding in Moldova increased from 67% in 2010 to 75% in 2014**. Despite the fact that proposals are also submitted under that budget line, the scheme is *not* competitive, the amounts are to some extent pre-defined and not linked to any performance evaluation of the applying Institute by CNAA. These flaws are mentioned also in the National R&D strategy (2014), which is based on a consensus of R&D stakeholders and where Article 35 (Point 10) refers to deficient research funding mechanisms, in particular institutional funding, which is not based on performance but rather on the remuneration needs of the staff and overheads.

Reversely, the **share of competitive funding has shrunk during the same period from 16.3% to 8.4% in 2014**. Obviously, such a marginal budget share cannot sustain a competitive R&I system and can raise complaints from potential beneficiaries outside ASM.

When considering the aforementioned facts, the need for an *increase of the competitive funding* is evident. **However, such an increase should in priority result from the overall increase of the R&I budget and not at the expenses of the institutional funding that could damage the already downgraded research community of the country.** The increase in competitive funding should be conditioned by measures to improve the *transparency and efficiency of the proposal evaluation* procedures.

The experience of Estonia with the development of institutional funding versus competitive funding after the independence of the country is instructive (see case study 5).

Case study 5: Institutional funding versus competitive funding in Estonia

The Estonian system of research funding was created after the re-establishment of the country's independence at the beginning of the 1990s, more than twenty-five years ago. The Estonian Science Foundation, established in 1990, started first steps towards competitive funding of research projects. However, during the first years institutional (block) funding formed still the major share of funding. In 1991, institutional funding amounted to 92.8% and project-based funding to 7.2% of total research funding. **In 1996**, the funding system was radically reformed. Three main funding instruments were introduced, and all three **were based on competition**:

- 1) Project-based grant funding:** Individual researchers submitted project proposals to the Estonian Science Foundation for grant funding. International peer review was used to evaluate the proposals, and the Estonian Science Foundation Council took funding decisions.
- 2) Targeted funding:** Targeted funding proposals were submitted to the Ministry of Education and Research by research institutes and universities. The Ministry with the help of a Competence Council managed the proposals, using international peer review. Targeted funding covered personnel and other research related costs. The aim of the instrument was to maintain the research capacity of Estonian science in the fields, where research was conducted at an internationally recognized level.
- 3) Infrastructure funding:** The funding of infrastructure was actually overhead to the targeted funding and was foreseen to cover general costs of maintenance and operation of the infrastructure of research institutes and universities.

This reform of the research funding system changed the proportion of competitive and institutional/basic funding. **After the reform competitive funding formed about 80% of total public funding.**

In 2003, after an assessment of the Estonian research and innovation funding system by external evaluators, the need for a **re-establishment of a separate baseline funding was recognized**. The Ministry established

a performance based baseline funding scheme for research institutes and universities. The proportion of **institutional/basic funding increased from 20% in 1990s to 30% in 2005.**

Further changes in the Estonian research funding system took place **in 2011. The Estonian Research Council⁴⁶** was established by merging the Estonian Science Foundation and part of the Archimedes Foundation. The Council awards **personal research grants and institutional grants** to research institutes and universities on a competitive basis. The Council also manages EU Structural Funds programs. **Opening the EU Structural Funds for funding of research and development activities in Estonia in 2007** changed the balance of competitive and institutional/basic funding again. The **proportion of institutional/basic funding decreased down to a level of 10%.**

There were several studies of the Estonian research funding system⁴⁷ and a report⁴⁸ that showed the need to increase the basic funding. Today, it is a common understanding in Estonia that **fresh money for research should go to the increase of institutional/basic funding.**

Project-based competitive funding gives to governments and funding agencies the possibility to steer research towards certain fields or issues, and to increase excellence by supporting the best research. Institutional/basic funding provides stable funding over the long term and gives research institutions autonomy, which is essential in case of basic research. It is important to **find a right balance of project-based versus institutional/basic funding**, which fits the development of the country – under its current conditions – best.

Recommendation 9: Increasing the share of the competitive funding for R&I

The share of the competitive funding in the overall R&I budget should increase as a means to stimulate competition and reward the most promising proposals and research teams.

However, such an increase of the competitive funding should in priority be based on *additional* funds that need to be allocated to R&I, and not through a reduction of the institutional part of the budget that will certainly negatively affect the science base and the overall R&I capabilities of the country.

The allocation of institutional funding eventually needs to be based on a solid assessment of the research capacities with the help of foreign experts. Project evaluations need to be performed to a large extent using international peer review standards.

Substantial modifications to the current R&I system and reforms as suggested in this report should come with respective financial means to make them happen. In Moldova, the situation with R&I financing is, however, marked by a very low level R&D expenditure as a share of GDP and a dire outlook regarding possible increases.

Recommendation 10: Moldova should strengthen its economic potential by gradually increasing its R&I intensity to reach the level of 2007 as quickly as possible. The ambitious reforms proposed by the panel to enhance the quality and performance of the Moldovan R&I system and its impact on the economy cannot be effectively implemented without such commitment by the government to sustained investments.

The Panel insists that such gradual increase of the R&I expenditure is mandatory, not only due to its current low level but also as an accompanying measure to the reform of the system. Just increasing the beneficiaries of a so limited budget can only discourage and further downsize the research personnel and capabilities of the country.

46. <http://www.etaq.ee/en/>

47. <http://www.tips.ut.ee/index.php?module=32&op=1&id=3697>,
<http://www.tips.ut.ee/index.php?module=32&op=1&id=3696>
<http://www.tips.ut.ee/index.php?module=32&op=1&id=3561>

48 https://riigikantselei.ee/sites/default/files/riigikantselei/strategiaburoo/tan/rdc_gunnar_okk_report_2015.pdf

5.2 Efficiency of the R&I performing bodies

The optimization of the structure of the R&I system of Moldova in terms of organizations performing research (research institutes of ASM, universities, research institutes belonging to line Ministries, businesses, NGOs) can significantly contribute to increase the system's efficiency. This is particularly true in former Soviet bloc countries, in which a strong segregation between the teaching and the research activities existed. Such a system is currently considered outdated since there is a clear need for **"osmosis" between research and education in order to boost research performance with economic impact.**

However, the transition towards a synergetic education and research system is complex and in several cases considerable barriers still exist. Removing those barriers in Moldova will certainly contribute to a better use of its skilled human resources and to the optimal use of research funding and research infrastructure.

The **assessment of the universities** is foreseen in the Code of Education (Art. 83) and it should take place every 5 years. It is implemented by the National Agency for Quality Assurance in Vocational Education. This system seems to be independent and well-functioning but it is still in its teething stage and requires consolidation. It addresses solely teaching while an overall evaluation (functioning, management, etc.) is not yet in place (the same applies for the research activities of the universities). Out of this assessment a classification/ ranking of universities is established and to some extent the legal provisions foresee that "the budgetary funds allocated to the higher education institution for research, development, innovation,... activities" are linked to this ranking (Art. 83.4b). In addition to that, universities need to be accredited by CNAA to be able to receive funds from the state budget for R&I administered by ASM (along the procedure stated above for the research institutes).

The mission of the universities is still primarily focusing on education and teaching, while research activities are still weakly developed therein. Nevertheless the new Code of Education⁴⁹ devotes a whole Chapter to "Scientific research in higher education" (Chapter IV) and places research next to educational activities (Art. 77.2 "*Higher education programmes include educational and research activities ...*") for all the categories (A, B or C) of universities (Art. 82.3-6). **Theoretically and according to the Code of Education, all university teachers must carry out R&D** (Art. 119 on the "norms of scientific-didactic and research activities") and they are assessed for these activities (Art. 120).

Interviews that the panel carried out with key stakeholders such as university Rectors and researchers confirmed that usually the **staff of universities is "overwhelmed" with the teaching load** and only a few individuals manage to conduct substantial research activities, as outlined in section 5. In terms of innovation, the Code of Education is equally promoting research and innovation. Moreover, it allows and encourages universities to be entrepreneurial (Art. 82.11 "*Higher education institutions may conduct business and technology transfer activities ...*"). Nevertheless, the innovation engagement of universities is rather weak and sporadic, even *ad hoc*, as well as the cooperation with the private sector.

5.2.1 Closer links between research institutes and universities

The **necessity to establish closer cooperation between research institutes and universities is widely recognized** in Moldova and formal associations are also envisaged in the Code of Education (Art. 84.2 "*Higher education institutions may also associate in consortia with research, development, innovation or creative organisations...*"). Formal legal and administrative barriers *do not* exist for researchers to undertake teaching and/ or administrative activities in universities (such as the position of a Rector). On the contrary, **throughout the Code of Science and Innovation the term 'scientific-teaching personnel' is used**, while in Art. 154.m "*practical teaching in higher education institutions*" is reported among the scientists' rights. And vice-versa, according to information received from interviews there are no formal barriers for universities' staff to undertake research in/with the ASM.

The degree of cooperation between universities and research institutions is very weak, given the:

- (i) heavy teaching workload for university professors (up to 1000 hours/year)

49. Code No. 152 of 17.07.2014 "Education Code of the Republic of Moldova"; Published: 24.10.2014 in the Official Gazette No 319-324 Article No: 634; Date of entry into force: 23.11.2014.

- (ii) lack of research grants incentivizing cooperation and/ or mobility between the two sides.

Recently the responsibility for awarding PhDs passed from ASM to the Universities. It is still debatable how and where the PhD candidates will perform their research work, especially in sciences and technical sciences (less in social sciences and humanities), when considering the generally low level of research activities in universities and their lack of research infrastructure, which is concentrated in the ASM.

For a fully functional Moldovan R&I system that optimizes the exploitation of the limited and precious human resources, funds and infrastructure, several options can be envisaged such as:

- **Developing competitive calls** that either as an "obligation" or as a "bonus" **foresee joint applications between universities and research institutes** (ASM, line Ministries), in particular for doctoral grants. Such joint grants would secure a decent salary for the PhD student involved and the necessary research costs. This joint research between ASM and universities would significantly contribute to the transmission of research expertise from the ASM's ageing research staff to the young generation studying in universities. Joint applications could also be envisaged for acquisition of new mid- or large-size research equipment or for setting up new labs/facilities.
- **Giving incentives** (e.g. in the form of higher institutional financing or "bonuses") to research institutes and universities that closely cooperate.
- **Using the doctoral studies** as a valuable "*bridge*" between Academy and the Universities, in particular via competitive financing of *joint doctoral schools* involving academy and university institutes. Some successful examples of joint doctoral schools were mentioned during interviews (e.g. Tiraspol State University in Chisinau with the Institute of Mathematics of ASM), but interlocutors also highlighted that a high bureaucratic effort is needed for this cooperation. This is clearly hampering the success of these new opportunities, and administration should therefore be reduced to a minimum.
- By **making the research infrastructure of the research institutes (ASM and institutes of line Ministries) available for collaborative research** between researchers and students at universities and from within the Academy, as well as with the business sector. This is of particular importance when considering that the bulk of scientific equipment and research laboratories belong to the research institutes while the universities possess considerable human resources and especially motivated students. Where appropriate, research infrastructure should also be made available to the private sector, paying for the services.

Estonia has used doctoral schools since 2005 for educating young researchers and linking up universities, research institutes and business (see Case study 6).

Case study 6: Doctoral Schools in Estonia⁵⁰

Doctoral Schools were set up in Estonia for the first time in 2005. Since then the Schools were project-based and funded by the European Structural Funds. In 2009, 13 new Doctoral Schools were selected for the period 2009-15 with a total budget of € 16.9 million. They **covered almost all study fields** giving good opportunities for participation for almost all doctoral students. Currently new Doctoral Schools are being established for the period 2016-2022. While the budget is not fixed yet, they are expected to cover again all study fields. In the new period, the Doctoral Schools will be **part of comprehensive projects** led by the universities **to support the R&D institutions and higher education institutions** (total budget for 2016-2022 will be about € 130 million).

The aim of the Doctoral Schools is to **improve the quality of doctoral candidate tutoring and to increase the efficiency of doctoral studies** in Estonia through interdisciplinary, international and national cooperation. In case of Doctoral Schools, **cooperation between Estonian universities is mandatory.** Previous experience showed that the project-based financing has led to a situation, where the central role of universities has remained in the background. In the new period, more consistency with other activities supporting doctoral studies is expected. To improve the management of the Doctoral Schools the Rectors Conference established a coordinating body including representatives from all Doctoral Schools. Apart from mobility opportunities, winter and summer schools and study programs, doctoral schools propose transferable and social skills training to promote **interdisciplinary research and enhance cooperation between universities and the private sector.** National activities that support PhD studies follow the principles of EU's Innovative Doctoral Training.

In addition to the Doctoral Schools, there are several other measures to support doctoral studies. These include **mobility programs** for out-going and in-coming students, but also **a program to train doctoral students in cooperation with businesses.**

Recommendation 11: Moldova should put in place strong incentives for cooperation and mobility between research institutes and universities to overcome the barriers linked to the country's fragmented *binary* education and research system, with teaching concentrated in universities (where the young generation studies) and research concentrated in ASM (with ageing research staff)

The need for enhanced cooperation between research institutes and universities is widely recognized in Moldova and is fully endorsed by the Panel. To succeed in this *rapprochement*, crucial to avoid the further development of a binary system with teaching-solely universities and a concentration of young talent, incentives should be developed in order to create a functional and integrated national research area.

Such incentives could include competitive calls for joint applications from research institutes and universities; strengthening doctoral study programs as a bridge between research institutes and universities; making research infrastructure of research institutes available to all the research community and in particular to students as well as to the private sector.

5.2.2 Evaluation of the research entities

Currently the only evaluation-like procedure for RPOs is the accreditation by CNAAB, based predominantly on metrics (e.g. publications and share of young researchers), that concerns both research institutes and the universities.

A systematic evaluation of public research entities, including both research institutes and universities, according to international standards and with the support of international peer review evaluation practices is missing. Such evaluation would be beneficial to better determine higher quality performance in the R&I system, as a starting point for a medium-term move towards performance-based funding of research institutions, i.e. allocating additional funds to best performing entities. A trap to be clearly avoided is that under the current situation the evaluation process gets used as a tool for downsizing the R&I capabilities of the country.

Moreover, when considering the necessity to introduce significant changes in the governance of the R&I system and in the efficiency and transparency of the evaluation procedures, it should be noted that the **evaluation of the research entities is a medium-term priority**, to be introduced only *after* reforms of the governance and funding systems. As a first step, *benchmarking* exercises

50. <https://www.hm.ee/en/activities/research-and-development/doctoral-schools>

among similar RPOs could set the incentives to gradually move towards an evaluation culture. Poorly performing entities should be invited to redress or to merge with other entities in order to generate stronger institutions. To illustrate this, the example of the Dutch approach to evaluation is presented as Case study 7.

Case study 7: evaluation culture in the Dutch science system - Netherlands

Dutch research has a **broad-based and strong tradition of evaluating research and research organizations**. Research organizations in the Netherlands are assessed on a regular basis, approximately once every five or six years. For example in 2008 an advisory letter was published on the Dutch Academy of Sciences (KNAW), and a new KNAW evaluation report was published in April 2014.

The assessment of research programs and institutes follows a **Standard Evaluation Protocol (the 'SEP protocol')** stipulating how assessments should be performed and drawn up by three key organizations: the Association of Universities (VSNU), The Netherlands Organisation for Scientific Research (NWO) and KNAW. The recent SEP concerned the period 2009-2015. Research assessments are designed to improve the standard of research in the broad sense, and to provide accountability for the research performed.

The system includes a number of standard features: assessments are performed by an external committee once every six years; a self-evaluation takes place beforehand; the assessment includes a site visit; a mid-term evaluation takes place between assessments; evaluation is based on a five-point scale with scores for quality, productivity; societal relevance and vitality, and feasibility; the organizations themselves determine the unit that is to be evaluated, which is referred to in the protocol as an 'institute'; evaluation reports are public

Assessments can be contracted out to an independent organization. One such organization is Quality Assurance Netherlands Universities (QANU).⁵¹ In March 2014 a revised SEP was published and presented to the Minister of Education, Culture and Science. In comparison to the previous protocol 2009-2015 some modifications were made: productivity as separate dimension has been skipped. Three assessment criteria; remain: scientific quality, societal relevance and viability; more attention for societal relevance; scientific quality and societal relevance are judged on three dimensions: demonstrable products, demonstrable use of products and demonstrable marks of recognition; attention for research integrity; attention for the supervision and instruction of PhD candidates in research schools and graduate schools.

Assessment of societal relevance: Growing attention for the evaluation of the social component of research has prompted a number of initiatives. The most important of these is the collaboration between NWO, KNAW, VSNU, the Rathenau Institute and the Netherlands Association of Universities of Applied Sciences, known as the ERIC project (Evaluating Research in Context). The Rathenau Institute conducted several projects under this partnership, and produced a guide. ERIC continued under the name ERiC+, and has been managed by NWO. It is now the responsibility of the different organizations assessing research to integrate the ERiC work in daily practice. The ERiC project has had an international counterpart known as SIAMPI. This project, led by the KNAW⁵² and the Rathenau Institute, has produced several studies and methodologies.⁵³

Recommendation 12: Introduce systematic evaluation procedures for public research organizations and higher education institutions with a view to linking public research funding to performance in the medium term, thus rewarding high quality research

The Panel recommends the introduction of performance-based evaluation procedures according to international standards, for all public research organizations and public higher education institutions in Moldova. Such procedures will eventually (in the medium term) allow for a differentiation of the better performing entities towards which additional funds should be oriented.

Benchmarking exercises should be implemented as a complementary measure for introducing an evaluation culture in the Moldovan R&I system. These evaluation procedures, providing a fair assessment of quality, excellence, and relevance of research and innovation activities in public PROs and HEIs in Moldova, should be the basis for allocating institutional funding.

51. <http://www.qanu.nl/en>

52. More details on the ERIC project, the Standard Evaluation Protocol (SEP), and other evaluation issues can be found at the website of the Dutch Academy of Sciences (KNAW): <http://www.knaw.nl/en/topics/kwaliteit/kwaliteitsbeoordeling-en-valorisatie>

53. The documents can be found at the SIAMPI project website: <http://www.siampi.eu>

5.2.3 Safeguarding the available R&I capacities

In the context of the envisaged reforms of the R&I system, it is crucial to **safeguard the available public R&I capacities of the country**. Safeguarding capacities shall not imply the maintenance of the *status quo* or the exclusion from the restructuring process of institutes or research units. It is simply considered essential by the panel not to reform the system in such a way that the current science base (further) deteriorates in its physical, human and intellectual capital built over the past decades, in the midst of complex circumstances. Safeguarding available R&I capacities of ASM, public research institutes under the various line Ministries, and the public higher education institutions is therefore essential.

The Moldovan Academy of Sciences possesses most of the country's research capacity and infrastructure. It is a key public research organization and focal point of research activities, and a hub of collaboration for higher education institutions and research institutes. It has the **status of an autonomous public institution** in R&D, functioning on well-established principles of self-administration.⁵⁴ Furthermore, ASM receives institutional funding for its infrastructure and administration, commensurate to its current situation. The panel considers that successful reforms of the Moldovan R&I system should ensure that the research capacity in ASM is maintained, and therefore ASM remains in possession of its research-devoted assets and infrastructure, including buildings and land.

The Panel also considers that the **autonomy of the universities, the other key players in the research system should be further solidly expanded**. The **public research institutes (under the line Ministries) and the higher education institutions will need to receive appropriate funding for their research activities and capacity building, and certainly not deteriorate any further**. The funding for public research institutions needs to be increasingly based on the evaluation of performance, as outlined above.

At the same time, for all public research institutions it will be necessary to **increase their public accountability** (e.g. through the regular evaluation of their performance or through performance contracts or via the appropriate exploitation and dissemination of results), which is currently not sufficient. In particular, for both ASM and higher education institutions, autonomy has to go hand in hand with increased accountability.

To effectively move from safeguarding to improving the country's research capacities, research institutes and universities will have to work together. ASM and its research institutes will have to take a stronger role in education, while Universities will have to strengthen their research capacities, as outlined above. These measures will ensure the sustainability of key research performers in the short to mid-term and in the context of the envisioned reforms.

Recommendation 13: Safeguard the public research and innovation capacity of Moldova, ensuring that the physical, intellectual and human capital of Moldovan research institutions is maintained, and eventually reinforced

The Panel considers that the available public research capacity in the ASM, in research institutes under Ministries, and in universities needs to be safeguarded. At the same time, these institutions need to significantly enhance their accountability. Maintaining the *status quo* or excluding certain institutes or research units from a restructuring is not an option. The autonomy of ASM and of the public universities should be preserved.

To ensure continuity in R&I capacity, the institutional funding of the system should be commensurate to the current situation of the different actors. This is the case for ASM, for example, which holds most of the country's research infrastructures. It is also the case for public universities and research institutes under Ministries, which will need to receive appropriate funding for improving their research capacity. Measures should be taken, in addition, to ensure that ASM remains in possession of its research-devoted assets and infrastructure, such as buildings and land. Measures should be put in place so that the funding for all public research institutions (ASM, research institutes, and HEIs) should be based on and in relation to performance evaluation.

54. See ASM (2015). The concept of reformation of the area of science and innovation.

Most of the human resources capacity of the Moldovan R&I system is under -or closely related to- the ASM: 19 academy institutes plus 15 research institutes administratively subordinated to different ministries (those were the former 'branch research institutes'). Both types of institutes receive funding and are scientifically supervised by the ASM, as soon as they get accredited by the CNAA. This accreditation process is foreseen in the Code of Science and Innovation (Chapter VI, Art. 90 to 102) and in fact it sets a set of *minimum criteria* that need to be met for being able to receive funding from the state budget for R&I administered by the ASM.

As mentioned earlier, **the national higher education system** includes 31 institutions, i.e. 19 state and 12 private universities. Since the **number of enrolled students is decreasing constantly since 2006**, a re-organization process of the sector is ongoing, involving the merging or the closing of entities.

The appropriate and structured **training of researchers**, the application of open, transparent and predictable **selection and promotion** processes, and a commensurate **career reward** system are three key pillars of high quality, dynamic, efficient, stable and sizeable research systems and of high-quality research outputs.

In this respect, **the current situation in Moldova is alarming**. The national R&D strategy (e.g. in Art. 34 SWOT analysis and Art. 35) openly points to the following weaknesses: the research community is shrinking, intense brain-drain occurred, research careers are not attractive for young researchers, and research staff is ageing. Decisive measures should therefore be taken to consolidate human resources in R&I and to attract the younger generation to research careers. A number of corrective actions were already introduced by the ASM and these must be encouraged and fueled.

R&D personnel in Moldova decreased fivefold since the country's independence and reached 5,038 (Head Count) in 2014. Low financing of R&I in the last 25 years led to brain drain both abroad and towards other sectors of the national economy.

This resulted in:

- **4.5 times lower than in EU number of researchers per 1 million people.** This gap is likely to widen, given the trends of emigration of talented young researchers and low attractiveness of scientific careers.
- **5 times lower than the EU average for new doctorate graduates per 1000 people aged 25-34**, in spite of a relatively high share of population with tertiary education.
- **4 times less PhD students per 1 million inhabitants than in Estonia and over 7 times less than Finland.** In 2014 the number of PhD students was 1628; in addition, around 264 foreign PhD students were enrolled (National Bureau of Statistics, 2015b).
- **Moldova being one of the few European countries where the number of PhD students decreased in the period 2004-2010.**
- **The share of students and PhD students in sciences and engineering 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. During the 1996-2014 period, almost 60% of PhD degrees were awarded in law, economics, education and medical sciences, while much less degrees were awarded in natural sciences or engineering. Several fields lack therefore qualified researchers.⁵⁵

In addition to the worrying figures in terms of the human resources stock of Moldova, **the employment and working environment for researchers in the country are far from attractive and career opportunities are very limited**. Cuts in public R&I funding combined with an unstable economic situation have had a negative cumulative impact in this respect. As an example, the **average monthly salary of a researcher in a public research organization was only €240 in 2014** (SCSTD, 2015) representing 0.66 x GDP/inhabitant, almost half as compared to France for example, where the average researcher salary is 1.16 x GDP/inhabitant. Salaries are

55. Data of EUROSTAT <http://ec.europa.eu/eurostat/data/database>, National Bureau of Statistics <http://www.statistica.md/index.php?l=en>, and National Council for Accreditation and Attestation <http://www.cnaa.md/>, 2014

much higher in several other sectors of the economy, leading to decreased quality of life, social status and peer recognition for researchers.

On the positive side, research and education organizations usually have a certain degree of flexibility in setting salary levels for their academic staff. Individual income can vary significantly depending on the research projects in which researchers are involved. However, **an ageing trend is observed in the researcher's population** with the average age reaching 49.1 years (SCSTD, 2015) and the share of young researchers dropping below 25% (National Bureau of Statistics, 2015a). The panel is of the opinion that it is important to provide incentives to the wider research community (with equal opportunities in grant competitions that encourage new entrants) while avoiding to discourage the most experienced researchers.

It appears clear that **any further downsizing of the R&I sector in terms of human resources risks having a persistent long-term effect** on the capacity of the Moldovan R&I system, undermining important national initiatives such as the opportunities offered by Moldova's Association to H2020. Systemic changes should be accompanied by adequate R&I funding to reward the best scientists, thereby limiting drawbacks during the transition towards a more efficient R&I system.

The national **authorities are aware of the precarious situation for young researchers and positive initiatives have been taken**, among which: quotas for young researchers in projects supported by public R&I funding; specific programs targeting the needs of young researchers; the acceptance by Moldova of the European Charter for Researchers and of the Code of Conduct for the Recruitment of Researchers. However, for a sustainable and solid effect to materialize, it is crucial to **identify young talents early on and to nurture them** in well-structured high-content PhD programs. It is also crucial to **recruit/ promote/ empower** young researchers in dynamic environments and to reward their scientific output and the social recognition of their scientific achievements and their impact.

Decisive and coordinated action should be taken in relation to the three pillars: **training, selection/ promotion, and reward** of sustainable human resources public policies in R&I. The Action Plan of the national R&D strategy foresees in its chapter 2 on "human, institutional and infrastructure" several important measures, the implementation of which needs to be continued and reinforced. These include a revision of the PhD studies and involving business representatives in this process, introducing an industrial PhD scheme, increasing the salaries of young researchers, and introducing support for international mobility of researchers. The mentioned three pillars will be discussed in more detail below, and will be re-taken by dedicated recommendations.

6.1 Training

In relation to higher education and training of researchers, Moldova needs a coherent and predictable structuring of researcher's careers as a key element for regaining the stakeholder's trust in the system. This is important for the general public and for scientists. Efforts should start early on:

- **At the Bachelor level** with the systematic identification and encouragement of most promising students that consider a research career, in a systematic manner. This should be reinforced during the **Master studies**. In particular, and in the context of the Education Code, it is particularly important that at least **some of the Master studies offered get integrated within doctoral schools**. This fulfills two complementary functions: a) familiarize the student with the research environment of doctoral schools and b) involve the master students in a research program. Towards the end of the master, the prospective researcher should be involved together with the potential PhD supervisor in proposing a PhD project in a national doctoral grant competition.
- **At the PhD level**, since PhD is the first professional experience as a researcher, it should be recognized as such. It is advisable that each PhD project is financed through a competitive grant system that comprises distinct budgetary lines for salary, research materials and mobility. The salary, unacceptably low nowadays, as revealed through forceful complaints of the PhD students interviewed, should be significantly increased.

Recommendation 14: Take determined action to improve the employment and funding opportunities, the working conditions and the career perspectives of public researchers, including through the further pursue of existing initiatives to nurture young and female scientific talent via structured and high-content PhD programs

This can be achieved by the early identification of talents. PhD students should benefit from a strong ASM/ universities interface. Existing measures addressed to young researchers (via dedicated programmes and/or quotas) should be further strengthened with adequate funding. This concerns notably the establishment of a competitive national doctoral grant system that allows reasonable income for doctoral students.

6.2 Recruiting/promotion/career pathway

As regards the **recruitment, promotion and career opportunities of researchers**, a clear reinforcement of open and merit-based recruitment procedures should take place in Moldova, i.e. to bring the country's institutions closer to the European Charter and Code, as well as through introducing measures to provide both career and leadership perspectives based on competences rather than hierarchical approaches. Researchers should be ensured that it will be the quality of their research output rather than informal networks of power that determines their professional future. This is particularly true for female researchers that are *under-represented* in top-level positions and in decision-making bodies. In a research environment with clear tensions between the stakeholders (mainly ASM and universities) a coherent pathway to the future depends upon a higher level of ASM-universities cooperation such as: similar recruitment procedures between universities and ASM institutes, in particular involving an increased number of foreign evaluators for higher positions; involvement in joint PhD projects/supervision; dual career pathways (ASM institutes and university).

A positive aspect of the existing legal framework in Moldova is that in principle it allows (legally) to combine teaching and research activities. However, **there is still a too strong segregation between researchers in ASM institutes and researchers (professors) in universities**. A particular issue, as mentioned above, is that the university staff is overloaded with teaching activities (up to 1000 hours/year) not leaving any margins for research, despite the (recent) responsibility of the universities in awarding PhDs.

Therefore the panel proposes:

- (i) A revision of the job descriptions in the institutes and universities in order to better incorporate and account the teaching and research activities;
- (ii) Freedom and flexibility for modifying the teaching/research ratio according to personal capacity, talent and the respective institutions' needs;
- (iii) Increased funding for research activities within universities, to drive down teaching workloads. This funding can come either from competitive R&I funding programs or by dedicating General University Funds (GUF) to research.

Since the first specific measures targeting young researchers have already been introduced (quotas, specific support programs), the level and especially the increase of the funding for R&I in Moldova (through well-planned actions in priority fields) is critical to attract the new generation of researchers that will reinvigorate the R&I capacity of the country.

Particular measures should be taken for increased financing of doctoral programs. The establishment of a national doctoral grants competition, as briefly described above, would have direct impact both on research career attractiveness and increased collaboration between ASM and universities.

Recommendation 15: Moldova should reinforce the recruitment, promotion and career opportunities of researchers through open and merit-based recruitment procedures based on competences and not on hierarchical approaches. The application by its institutions of the European Charter and Code for Researchers should be incentivized

This can be achieved by introducing similar recruitment procedures between universities and ASM institutes, in particular involving an increased number of foreign evaluators for higher positions, involvement in joint PhD projects/supervision and dual career pathways (ASM institutes and university). The still strong segregation between researchers in ASM institutes and researchers (professors) in universities can be overcome by a revision of the job descriptions in the institutes and universities in order to better incorporate and account the teaching and research activities; freedom and flexibility should be given for modifying the teaching/research ratio according to personal wishes, talent and the respective institution's needs.

6.3 Reward and social recognition

Reward and social recognition are key elements for encouraging the most talented to embrace a scientific career and to pursue it. As key measures, it is urgent to:

- Establish **salaries which progressively and steadily move towards the EU standard** in terms of purchasing power parity. It is urgent to do so especially for the researchers closer to the entry level.
- **Consolidate stimulating measures and incentives**, such as financial prizes for significant scientific output.
- **Increase the leadership perspectives of the most productive scientists** (as judged by internationally recognized standards). To achieve this, institutions promoting highly productive scientists should be rewarded.
- **Evaluation, and its impact on career, is critical.** Internationally recognized metrics should be used, together with high transparency of all evaluation processes.
- **International mobility but also science-business mobility** should be strengthened, with special attention to **return conditions** from abroad. The latter is particularly important for young researchers returning from post-doctoral studies abroad, for which specific positions should be secured. In this context the Moldovan scientific diaspora is relevant as point of contact for cooperation and mobility abroad.
- Increasing the **social recognition of researchers'** scientific achievements, in particular through media actions and grassroot activities such as the "Science Slam".

Whereas each of the measures presented above is important, their combined added value supersedes the impact of any administrative reorganization. Moreover, the recommended improvements in the higher education and training, selection and reward procedures must be run concomitantly to guarantee reform ownership by the Moldovan research community at large. Case study 9 below presents the key features of the "TALENTS" program, a proven scheme implemented by Austria.

Case study 8: support for human resources in R&I– the Austrian program TALENTS

The Austrian program TALENTS⁵⁶ aims at supporting individuals in their R&I careers. It backs the **discovery, support and development of talented individuals that undertake careers in technology and innovation** in priority areas such as ICT, material sciences, production technologies, life sciences, security, environment and energy, space, mobility (transport).

All funding is allocated via **competitive calls** with clearly defined expectations and a selection of successful proposals by independent experts. The calls are organized by the Austrian Research Promotion Agency. The program owner is the Austrian Ministry for Transport, Innovation and Technology, that covers the costs.

1) Young talents: For pupils aged around 15 – 19 years the program supports internships of 4 weeks during summertime in research institutions or research-intensive enterprises in natural and technological sciences by funding the organizations that offer traineeships. With this measure, young people get encouraged to take up studies in technology. Each year, the best interns get an award by the Minister for Transport, Innovation and Technology in a public ceremony. To engage children, the program-line "Talents Regional" funds the networking of schools with partners from research and industry to offer attractive education around research, innovation and technology.

2) Professional talents: To facilitate job search the "Austrian Job exchange for R&D and Innovation" action was developed as a free-of charge on-line portal informing about job offers in the technology area. Austrian researchers living abroad are supported in their return to Austria by "Career grants" covering costs for relocation and professional integration via the "Dual Career Grant" funding.

3) Female talents: To foster equal opportunities for women in innovation and technology, the funding-line "fem-tech" provides: support to R&I-intensive SMEs and research institutions to implement measures which encourage more gender-balance. "Fem-Tech-Career"-projects support organizations to employ more women in natural sciences and technology. Female students are offered internships partly financed by the program. Additionally, research projects to investigate gender aspects in Research and Innovation are financed.

The program has been positively evaluated by external independent experts in 2014, and the expert recommendations were used for its further development. The next evaluations are planned for 2018 and 2020. The program will be operational until 2020.

Recommendation 16: Create incentives for rewarding researchers' careers through better salary rewards, in particular for researchers closer to the entry level, social recognition of scientific achievements

This recognition includes financial prizes for significant scientific outputs; increasing leadership perspectives for the most productive scientists; performance-based evaluation of scientific work, with direct impact on career; strengthening international and science-business mobility with particular attention to return conditions from the Moldovan scientific diaspora; and increasing media actions and grassroots activities such as the "Science Slam".

6.4 International mobility & EU Framework Programme participation

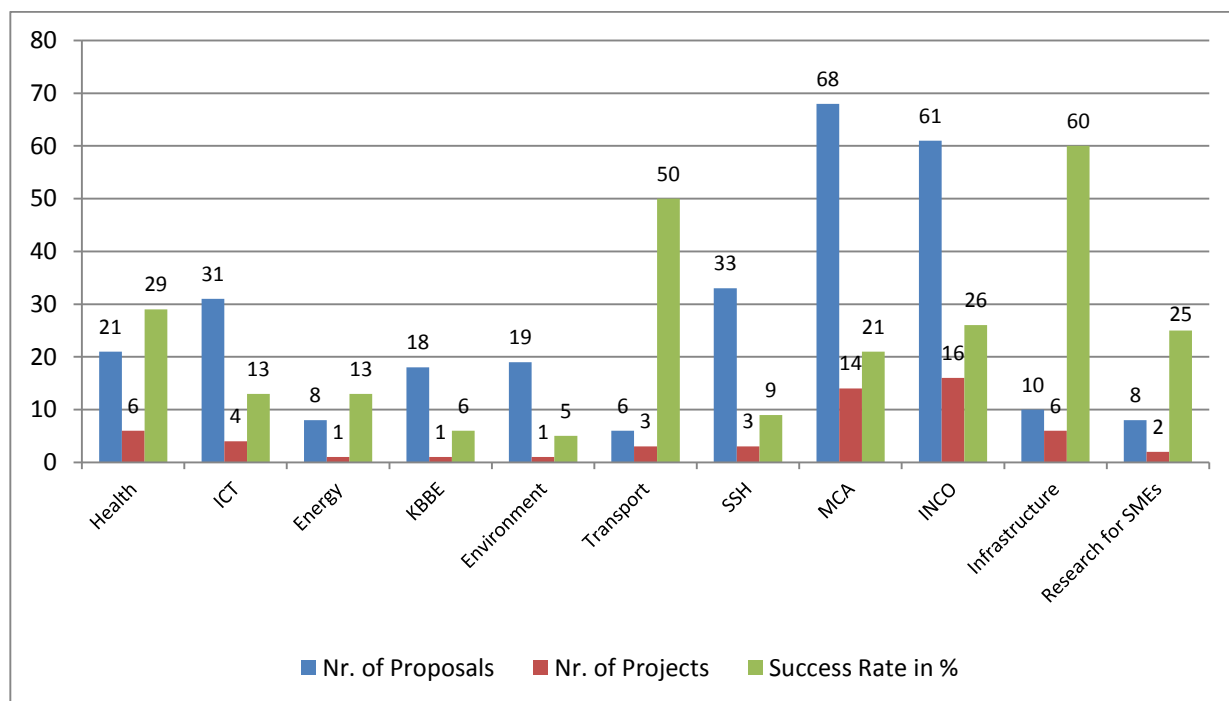
A priority for Moldova's international scientific cooperation is the **integration of the country in the European Research Area**. The Republic of Moldova became associated to the Seventh EU Framework Programme for R&I (FP7) on 1 January 2012 and to Horizon 2020 on 1 January 2014. To make of association a success, the national authorities responsible for R&I undertook a number of support measures: Action Plans on the implementation of the associated status, a network of National Contact Points was established, regional information points were set up (in Comrat, Cahul, and Balti). The Moldovan Office for Science and Technology (MOST) was established in Brussels. A Catalogue of research groups from Moldova and regular awareness raising actions on European programmes among the local scientific community were important too.

As regards **FP7**, Moldovan teams were involved in 337 project proposals. Out of these proposals 58 were accepted for funding, and €4.15m allocated to Moldovan teams⁵⁷.

56. <https://www.ffg.at/en/talents>

57. Raport de activitate al Centrului Proiecte Internaționale al Academiei de Științe a Moldovei pentru anul 2014, http://cpi.asm.md/wp-content/uploads/2012/08/2014-CPI-RAPORT_Final-Jan-25.pdf

Figure 6: Participation of Moldova in FP7



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

R&I becomes ever more important in the context of the successful integration of Moldova in the European Research Area. For the newer Member States of the EU from the region, association to the EU R&I Framework Programmes was an important milestone on the way to full integration. Moldova aims at following a similar path, having signed in mid-2014 the Association Agreement to the EU in parallel to the Association Agreement to FP7, and later on to the Horizon 2020 Programme. A relative success of Moldovan research teams in winning grants in FP7 and Horizon 2020 proved the existence of niches of excellence and strong ties of Moldovan science with ERA. The association provides a wide range of opportunities for Moldovan scientific and business stakeholders, from basic research up to pre-commercialization activities, which need a proactive engagement from national authorities to be fully exploited.⁵⁸

Recommendation 17: Build on Moldova's successful efforts to increase its integration in the European Research Area by fully exploiting well-established instruments and tools including notably the network of National Contact Points and the Moldovan Office for Science and Technology ("MOST") located in Brussels, as well as set up additional actions to support the submission of promising research proposals to the EU Framework Programmes

Moldova should continue its good efforts and success in integrating with the European Research Area (ERA). All available instruments at the EU level should be used to strengthen the local research community, to integrate it in international research and innovation networks, and to boost the research and innovation capacity in the country in general. Specific Horizon 2020 schemes targeted at "low-performing countries" should be especially promoted and used. These include the "Spreading Excellence and Widening Participation" program, the ERA Chairs, and the twinning and teaming funding lines.

58. Minutes of the EU Moldova Association Council (March 2015) and the Association Committee (October 2015)

7 BOOSTING BUSINESS INNOVATIVENESS AND SCIENCE-BUSINESS LINKS

The involvement of the business sector in R&I activities remains an issue for many EU Member States. This is **particularly true in Eastern Europe** due to the tremendous and complex socio-economic transition that these countries faced and to the continuing lack of effective communication between research and business. To redress that situation, **specific measures have been developed in many EU Member States** (favorable framework conditions for business R&D and innovation, programs incentivizing business participation in research actions, industrial PhD programs, innovation vouchers, or clustering initiatives). The EU's Framework Programmes are constantly promoting the participation of business entities in research projects.

In Moldova, however, the innovation capacity of business and in particular the participation of the business sector in research activities remains marginal and redress measures need to be enacted rapidly to increase the engagement of the business sector in R&D and to push forward stronger science-business links.

7.1 Business innovativeness

At the time of the independence of Moldova, at the beginning of the 1990s, the R&D sector in general and the level of R&D in state enterprises was relatively well developed. This situation changed dramatically since then, with **companies getting increasingly disconnected from their former research partners and markets**, while R&D funding from public sources declined drastically. As a consequence most of the industrial R&D potential was lost during the transition years up to now. It is characteristic that the last data of the National Bureau of Statistics on research performers by sectors (2009) mention **only eight private R&D entities**, four mixed (public and private) and one joint venture. Even if these figures are far from complete, since the Bureau of Statistics does not systematically collect data on research performing organizations in the business and the private non-profit sectors, it shows the drastic decline of the business innovativeness.

Estimates are not encouraging **and integration of the enterprise sector into the national innovation system is a difficult task**. The country ranks overall in 84th position of 140 countries in the Global Competitiveness Report (GCR) for 2015-2016. On the sub-index Innovation and Sophistication Factors it ranks only in 128th position (WEF, 2016). 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 favorable for R&D performing activities. Industry is focusing on trade and low-tech commodities. Low costs continue to be the main source of competitiveness while innovation in industry and services is based mostly on foreign equipment and technology acquisitions instead of in-house technological solutions, since few Moldovan enterprises possess innovation departments (partly due to brain drain). Data of the UNESCO Institute for Statistics show that the business-enterprise sector performs 19% (figures for 2011, UIS 2015), but no clear picture of research performance in this sector is available.

In general R&D funding and performance of the business enterprise sector are quite moderate in comparison to EU countries. In that context, discussions among stakeholders are ongoing about the **necessity to increase the Business Expenditure for R&D (BERD)**, however, an explicit national target for BERD has not been fixed yet.

The **majority of support measures taken so far for improving the R&I capabilities of Moldova are targeting PROs (supply-side of innovation)** and only few stimulate business R&D and innovation activities (direct funding for business R&D and demand-side measures). Moreover, 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. The National R&D strategy of 2014 has identified this weakness and it highlights (in Article 35, point 10) a "low competitiveness in the access to funding, which is also reduced because the private sector is not admitted freely to the public research funding means".

A positive innovation support measure was introduced in 2007 with the Law on **Science and Technology Parks, and Innovation Incubators**. As a result of the law *three scientific-technological parks* (Technopark Academica - without specific thematic focus; Technopark Inagro - specialised in ecological and intensive agriculture; and Technopark Micronanoteh - specialised in nanotechnologies and microelectronics), as well as *seven innovation incubators* were operational in 2014 with 33 companies having a resident status.

The **firms that operate in technoparks and incubators are approved by the Supreme Council for Science and Technological Development (SCSTD) of ASM**. They benefit from

fiscal incentives, low tariffs on leasing of premises and on public utilities. In addition, the intellectual property agency AGEPI covers 95% of their patenting costs and tax incentives were introduced by law but never applied and are currently phasing out.

In terms of **Intellectual Property (IP)**, **Moldova has a relatively well-regulated framework** coordinated by the State Agency on Intellectual Property (AGEPI), and a rather high patenting activity. However, when examining the patenting data, the weaknesses of Moldovan R&I system in terms of business innovativeness are becoming evident.

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 5 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.

According to the annual reports of the 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 and organizations.

More recent data (for 2014) show that 223 patents were filed under the national procedure. Most of the patent applications were filed by physical persons (40%), research institutes of the ASM and other (27%), universities (23%), institutes of the Ministry of Health (2%), while *only 1% was filed by the business sector* (Data from interview with AGEPI; for 2014).⁵⁹ 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) allocated to the business sector has *decreased*, as a result of the de-industrialization of the country.

The **exploitation of patents in Moldova is also weak** (approx. 3.5%) compared to the World's average (7 to 8%). The Agricultural sector (production of new plants) is the most active in terms of exploitation with approximately 15% of the total exploited patents, while the Software Production and Telecommunications sectors (accounting for 8% of the GDP) are not patenting. Despite the fact that these sectors are often applying for copyright, such inexistent patenting activity could also be attributed to the *inadequacy* between research orientations and economic strengths of the country.

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.

Innovation financing, another key element of the framework conditions for business innovativeness, **is also weakly developed in Moldova**. In general, **bank financing remains the main source of external funding** for companies, but credit penetration is limited compared to similar economies and a large number of companies consider the lack of access to credit as a very significant obstacle to their development. **Alternative nonbanking financial institutions and support measures are not well developed yet**, despite the fact that their need has been recognized and the Innovation Strategy (2013) foresees the development of a law on venture funds and support for linking Moldovan SMEs with "business angels".

When considering the aforementioned facts, it is not surprising that **the economic effects of R&I outputs are rather limited**. High-technology exports represented only 6% of the manufactured exports in 2011 (World Bank, 2015). On the other hand, the share of computer and communications services in the total exports of Moldovan services is relatively high (33.8%) and comparable with Eastern European countries (EEC). This indicates high competitive potential of this sector that should be further consolidated through R&I activities.

59. See also AGEPI (2015), Annual Report 2014, http://agepi.gov.md/sites/default/files/bopi/ra_2014.pdf

7.2 Science – business links

The **public R&I sector is not sufficiently oriented towards the economic and societal needs** of the country and, in many cases, appears not to be aware that it would have a role to play towards the business sector. Public R&D is therefore not producing sufficient research results *relevant* to companies or is not working with business on joint innovative projects, as it has been highlighted by several stakeholders from the business sector. In addition, a **favorable legal environment and support for spin-offs from research organizations and universities and for new start-up firms is missing, as well as Technology Transfer Offices (TTOs)** that only exist in few universities.

The main **support for public-private knowledge transfer and stimulation of innovation** activities is provided by the Agency for Innovation and Technology Transfer (AITT) through its annual call for Innovation and Technology Transfer Projects, which link-up research organizations with companies. The approach is bottom-up, covering a very broad spectrum of thematic fields. The projects are supported for a two-year period and require a co-funding from non-public sources of at least 50% of the total budget. However the overall budget for such projects amounts approx. **2% of the state budget for R&I**, with a total of approx. 5.4 million Euros for the period 2007 – 2014. Such figures are obviously *insufficient*, as it is widely recognized in the country.

For the **stimulation of business innovativeness** several useful measures are pointed out in the National R&D strategy (2014), the Innovation Strategy (2013) or the SME Strategy for 2015-2017 (e.g. making public R&D funding accessible to business, diversifying financial innovation support instruments via vouchers, etc.) and taken up also in this report. It is now necessary to *confirm the importance of the business sector, of the business innovativeness and of the science – business links in the overall strategy and governance for R&I in Moldova* and to *implement a coherent set of measures* that will serve this goal.

Increased public investments will be needed for achieving these goals, especially **towards leveraging business sector engagement in R&I. Setting up a national target for BERD could help as well.** A coherent set of measures is needed for the improvement of the framework conditions for business innovativeness, with emphasis on *access of business to public R&I funds*; strengthening *innovation financing*; improving *sharing mechanisms of IP rights*; improving *R&I statistics*.

The **participation of the business sector in research activities and in public R&I funding should be promoted.** In that respect, ***the "accreditation" process for receiving public funds for research and innovation should be removed*** since it only constitutes an administrative barrier to block potential competitors. In Article 94/13 of the National R&D strategy (2014) the intention is pointed out to create the conditions for access of business to the R&D funds. The implementation of this strategic goal needs now to be accelerated and achieved.

Appropriate **innovation investment mechanisms** (venture capital, business angels, public procurement of innovative goods and services, etc.) are foreseen in the Innovation Strategy (2013) and in the Strategy for SMEs (2012), but still need to be setup or strengthened, while adequate capital should be secured from public or private Moldovan or foreign sources.

Despite the rather well developed IP framework in Moldova, the mechanisms that regulate the sharing of rights and benefits among authors needs improvements, especially in cases of co-financing from the private sector (ERAWATCH, 2014). As it was mentioned in other parts of this report, the R&I statistics in Moldova need to be improved. In the case of the business R&I activities, the data are almost inexistent and therefore a serious improvement is needed in that field in order to assess the impact of measures addressing business innovativeness.

Tax incentives for business R&I activities have been introduced in several EU Member States. However, their success depends on a robust, simple and transparent tax system otherwise their implementation can result to heavy bureaucracy, corruption and increased administrative costs. **The introduction of tax incentives in Moldova for business R&I activities could be an option, but this should be assessed in the light of the aforementioned pre-conditions** and of the experience with tax incentives up to date. The Panel does not recommend the introduction of tax incentives at that stage but if it is envisaged, it should be accompanied by sound monitoring.

The **merging of the SME agency ODIMM with the Innovation Agency AITT into the planned Agency for Research and Innovation could be an option** in order to *concentrate resources* and to provide a single entry point. However, the Panel cannot recommend such merging before verifying the compatibility of the activities and services provided by the two entities and the *added value* that can result from the merging.

Recommendation 18: Improving the framework conditions for business innovativeness by: *removing* the artificial administrative barrier of Accreditation for the allocation of public R&I funds to the business sector; enhancing support to business R&I through creating better opportunities for innovation financing, improved sharing of IP rights, and a legal environment supportive of spin-offs and knowledge transfer.

The Panel does not recommend the introduction of R&D tax incentives at this stage and in the future, unless accompanied by sound monitoring. The merging of the SME Agency ODIMM with the Innovation Agency AITT into the planned Agency for R&I could be envisaged.

7.3 Increasing support measures for innovation

Direct cooperation between research and business in joint projects is the rule and not the exception anymore in most EU Member States and through the EU Framework Programmes. **The general assumption in Moldova that there is no demand from business for research or for research results should be transformed into a spirit of true collaboration.** To achieve this, the right incentives are needed.

A realistic target for business R&D participation, certainly much higher than the current **2% of the annual R&I budget, should be agreed.** This would strengthen the few and weak support programs currently implemented by AITT to leverage business investment in R&D. **Emphasis should be given to business-driven schemes** (e.g. Vouchers, etc.) "since the business sector better knows its needs" as it was correctly stated in interviews with business representatives.

Such business innovation and business-academia collaboration support programs, which already exist in many EU MS, should be implemented on a competitive basis, with a **selection of successful proposals by independent possibly international evaluators.** These programs should be accompanied by solid evaluations.

- *For business innovation support a **bottom-up funding scheme could be set up to partly support the costs of individual R&I activities** of companies (with the remaining costs being covered by the beneficiary itself). An example of such a funding scheme in Austria, being successful since many years, is the "General Programme" ⁶⁰ to support R&D projects by single firms to develop innovations in all fields of development of products and services.*
- *For business – academia cooperation in R&I a funding scheme on the basis of **individual projects at short or long term** could be setup. An example for such a program to encourage longer-term cooperation is described in Case study 9, while in Case study 10 a successful pilot program for 'Innovation Vouchers' in Moldova is presented.*

Stimulation of direct research-business cooperation on joint R&I projects has a long tradition in Austria, and one of its main schemes is the COMET program.

Case study 9: Stimulation of research and business cooperation in Austria – program COMET

The Austrian program **COMET (Competence Centers for Excellent Technologies)**⁶¹ was launched in 2006. It supports **long-term cooperation between academia (research institutions and universities) and industry.** At its core it is a jointly defined by science and industry.

Funding mechanism: all funding is allocated via **competitive calls for proposals** with clearly defined expectations and a selection of the successful proposals by independent experts. The calls are organized by the Austrian Research Promotion Agency (FFG). Program owners and funders are the Austrian Ministry for Transport, Innovation and Technology and the Ministry for Science, Research and Economy. The costs of research and innovation activities are partly covered by the program and co-financed by participating enterprises.

There are three program lines with increasing degrees of project-size and integration:

60. For more information: <https://www.ffg.at/en/general-programme>

61. <https://www.ffg.at/en/comet-competence-centers-excellent-technologies>
See also the factsheet on the current K1 call:
https://www.ffg.at/sites/default/files/downloads/2015_comet_fact_sheet_k1_4call_en_final.pdf

- 1) **Program line K-Projects:** The objective is to initiate high-quality research with science-industry cooperation with a medium-term perspective (3-4 years) and a clearly defined subject having the potential for further improvement. This is to enable those consortia and research topics to participate, whose potential is not yet sufficient for a K1 application. Quota of public funding is 35-45% of the total budget and reaches up to € 0.675 million per year.
- 2) **Program line K1 Centers:** The objective of K1 centers is the initiation of high-quality research defined jointly by science and industry with a medium to long-term perspective (8 years). K1 centers implement top-level research with a focus on scientific and technological developments and innovations to qualify for the future markets. Quota of public funding is 40-55% and reaches up to € 1.7 million per year.
- 3) **Program line K2 Centers:** The objective of K2 centers is bundling of existing national expertise in the long-term (10 years) and cooperation with the world's leading researchers, scientific partners and company partners in joint strategic research programs at highest level. This is to achieve long-term strengthening and a significant increase of Austria's attractiveness as a research location internationally. Quota of public funding is 40-55% and reaches up to € 7.5 million per year.

All three program lines are thematically open, but projects must show a clear focus in line with the objectives of the program. Special support will be given to those research activities which operate at the cutting-edge and which also promise a high international profile. Today, some 1,500 researchers from science and industry work on jointly defined research programs at more than 50 centers and networks. The **COMET competence centres** programs are internationally recognized as good-practice model and have been **among the most successful technology policy initiatives in Austria**.

Innovation Vouchers were implemented and supported in Moldova in 2015 for the first time, and they proved to be a useful tool for SME-research cooperation (Case study 10 below).

Case study 10: Innovation Vouchers for joint innovative projects among SMEs and research institutions

Innovation Vouchers, a funding scheme for **small scale joint innovative projects among SMEs and research institutions** was implemented in Moldova for the first time in 2015. In the frame of the EU FP7 funded ener2i project (www.ener2i.eu) the AITT, ODIMM and their international partners from Austria (Centre for Social Innovation – ZSI) and Germany (North-Rhine Westphalian energy agency) launched a call, evaluated and financed projects for **a budget of € 4,000 per Voucher**. 11 such Voucher projects were supported for a total sum of € 44,000. The competition was financed jointly by the EU via the ener2i project, and the Central European Initiative (CEI) with funding of the Austrian Development Cooperation (ADA).

The Voucher was allocated to an SME, which had to collaborate with a research partner. The research work is therefore driven by the needs of the company, as opposed to a traditional approach, where research results are generated and should then be applied and transferred to business or society. The Voucher budget could be spent on R&D related manpower needed for project implementation (e.g. technology or market studies, prototyping, energy or innovation audits, etc.) or travel arrangements facilitating knowledge transfer on a national and international level. Funded projects were implemented over a six months period and most projects have finished in early 2016.

The Voucher projects cover different energy related topics, including solar, construction material, biomass for energy production and heating, etc. Funded projects are accessible at the project website: https://ener2i.eu/innovation_vouchers/funded_projects

As a result of the successful implementation of this funding activity, the AITT approached the Ministry of Economy with a request to launch another competition for Vouchers, but without a thematic restriction. This competition should be financed from national resources.

Recommendation 19: Increasing support measures to foster business R&D engagement in R&I activities, including allocating a much higher share of public funding (than the current 2%) to leverage business R&D investments through public funding

7.4 Involving the private sector in research management

Dialogue, networking opportunities and direct contacts in joint forums among business and research representatives constitute an important opportunity for exchange of opinion and for furthering the cooperation between the two sectors. A specific measure that can significantly improve the communication between business and academia is the **participation of private sector representatives in management structures or Advisory Boards of research entities**. It will contribute to the increase of the *understanding* of the business' needs and, vice-versa, of the research sector's capabilities. Such provision seems missing in the Code of Education, which however (and surprisingly) envisages participation of business representatives in the

Management Board of institutions of general education, i.e. primary and secondary schools (Art. 49.3).

For the same reasons, the participation of business representatives in the Board of the R&I Agency (to be established) is of paramount importance.

Recommendation 20: Invite business representatives to become part of the Management or Advisory Boards of higher education institutions and public research organizations (universities and research institutes), as well as to the Board of the proposed R&I Agency

The participation of business representatives in Management or Advisory Boards of PROs and HEIs, as well as of the R&I Agency to be established will substantially increase the understanding of the researchers about business needs and, vice-versa, the recognition of the national research capabilities that could be exploited by the business sector.

7.5 Business to Academia Mobility and traineeships in companies

In Moldova inter-sectoral business mobility is usually observed from the public research sector to the private sector, motivated by higher salaries and resulting in an interruption of research careers. This negative connotation should not hamper the development of an appropriate framework for **mobility schemes aiming at a brain-circulation between the two sectors**, an essential element for business – academia cooperation and business innovativeness.

Especially for the business sector, a **mobility scheme should allow qualified personnel to implement short-term research in academia or to teach in business oriented courses and seminars**. In parallel, *research traineeships in companies* should be organized, possibly as part of lifelong learning activities, allowing a better understanding of the benefits research can provide, paving therefore the way for stronger business – academia links.

Recommendation 21: Business to academia mobility and traineeships in companies should be encouraged to foster brain circulation

A mobility scheme should allow qualified personnel from the business sector to implement short-term research in academia or to teach in business oriented courses and seminars.

In parallel, traineeships in companies will increase the understanding of the benefits research can provide, stimulating therefore the business innovativeness and the business – academia links.

7.6 Improving Innovation capabilities of PROs

The **PROs in Moldova continue to be disconnected from market needs** and the business culture and therefore a set of measures is needed to fill this gap. Among these measures the following are recommended:

- **Extending entrepreneurship education:** Entrepreneurship courses are to a limited degree introduced in the universities' curricula. They need to be extended and accompanied by equivalent seminars addressed to the researchers in institutes, e.g. in the form of lifelong learning activities (that are nearly absent in Moldova, with less than 1% of employees taking part in them – PRO INNO Europe, 2011).
- **Extending the presence of Technology Transfer Offices (TTOs):** The examples of the few operational TTOs should be followed by all major universities and research entities in Moldova. Adequate training should be secured to the TTOs personnel, possibly through international support programs.
- **Supporting the creation of spin-offs:** The legal framework for the creation of spin-offs should be rapidly operational and supported by adequate incentives.

Recommendation 22: Improving the innovation capabilities of public research organizations through extending entrepreneurship education and technology transfer offices, and through an appropriate legal framework in support of spin-offs

A coherent set of measures is necessary for improving the innovation capabilities of PROs and for filling the gap between them and the market. Among them, the strengthening of entrepreneurship education, the multiplication of TTOs and the support to spin-offs through an appropriate legal framework and support incentives, should be considered as priorities.

7.7 Assessing national support for innovation infrastructures

The demand of the business sector (and notably SMEs) for support infrastructures for innovation such as Technological Parks and Incubators is strong. However it is not evident if these structures are clearly promoting innovation or are just (mis-)used. In that respect an ***objective assessment of the support structures using international standards*** and ideally international expertise, would be helpful before engaging additional resources in that field.

Recommendation 23: Assess the national schemes in support of innovation infrastructures such as technology parks and incubators

Before setting-up additional Technological Parks and innovation incubators an objective assessment of the functioning of the existing ones would be necessary in order to obtain confidence on their roles and impact, optimizing their functioning wherever necessary.

Such assessment should be based on international methodological standards and support could be secured from international organizations and donors.

8 CONCLUSIONS

Although, research and innovation (R&I) were not the major forces driving recovery and growth in the Central and Eastern European Countries during the 1990s and at the beginning of the 21st century, they have become an increasingly important policy area with clear recognition of their role as growth and competitiveness enabler, and for *rapprochement* with the European Union.

The Moldovan authorities decided to use the Horizon 2020 Policy Support Facility *peer review* instrument to improve the design, implementation and evaluation of national R&I policies.

The President of the Academy of Sciences of Moldova expressed his interest and commitment for a peer review in a letter dated 26 May 2015, where a number of areas needing evaluation and implementation of further structural changes were specified. This shows no doubt that the country has the necessary courage to upgrade and modernize its R&I system in order to build its capacity more strongly, increase overall quality and achieve "more bang for the buck".

In line with this request, the aim of the PSF Peer Review has been to provide external advice, peer input from policy-makers, and operational recommendations to the Moldovan authorities on possible reforms to undertake within the framework of the new National Strategy for Science and Development 2014-2020 focusing on the following focus areas:

- (1) Increasing the efficiency of public R&I funding and the quality of the R&I performing bodies and instruments;
- (2) Improving the policies for human resources and mobility of researchers;
- (3) Boosting business innovativeness and science-business links; and
- (4) Increasing R&I impact by properly defining the policy instruments.

On top of that, the Peer Review Panel also decided to focus and provide recommendations on the overarching topic of the governance of the R&I system.

After extensive desk research and intense country visits, including tens of meetings with officials and R&I stakeholders, the Peer Review Panel acquired a deep understanding of the national context, including the recent complicated social and political situation. This has allowed the panel to formulate 24 operational recommendations for reforms built on the basis of quantitative and qualitative analysis, and at times background assumptions. The aim of the panel recommendations is to preserve the best of the Moldovan R&I system and to unlock the potential of existing resources towards excellence but also relevance of R&I for the Moldovan economy and society.

Taking into account the complex political and economic situation of Moldova, the historical evolution of its R&I system and its scarce human and financial resources, the Panel developed recommendations relying on several guiding principles.

To derive these policy messages and the recommendations that underpin them, the Panel relied on a number of guiding principles. *First*, reforms should not create a risk of deteriorating the physical, intellectual and human capital currently existing in the Moldovan R&I system, built through periods of hard work and hardship. *Second*, the reforms should target the efficiency of public spending on R&I with lean and simple administrative structures and transparent procedures accompanied by effective financial instruments. *Third*, the political accountability of the system is vital. *Fourth*, only through high quality science, based on competition, performance and merit, and through impactful innovations incentivized through adequate framework conditions, will the country's R&I system be in the position to strongly support the economic development of Moldova. *Fifth*, Moldova's human resource capacity is a crucial asset of the nation; decent salaries, career opportunities and supportive working conditions for researchers are essential to avoid brain drain and the progressive depletion of its intellectual assets. And *sixth*, promoting an evaluation and a performance-oriented culture must be at the heart of the reforms, both in terms of measuring institutional and personal achievements.

Within the given PSF methodology and in line with its guiding principles, the Panel proposed a list of recommendations in seven major policy areas outlined upfront in this report. According to the panel's opinion, all these areas are equally important. However, some are fundamental. In the Panel's opinion the highest priority should be given to ensuring that adequate R&D funding goes hands in hands with ambitious reforms, and on establishing a Ministerial responsibility for R&I policy-making and strategy development. Strong political support for R&I policy is absolutely

necessary to lift it to the level comparable with other development policies. This new Ministerial responsibility should be strengthened and complemented by establishing an independent R&I implementation Agency, which should be accountable and report to the Ministry.

The Panel recognizes the need to preserve the current level of research capacity in Moldova, located in its research institutions, as a *minimum minimorum*. Increasing R&I expenditure will be a capital necessity in the medium run. The implementations of the reforms proposed by the panel can only work in practice if they are accompanied by adequate funding to allow Moldova to make the most of its economic potential derived from its knowledge capacity. Increasing R&D investments without reforming the R&I system, or reforming the R&I system without an increase from the currently very low levels of R&D spending will only conduct to marginal and short-term results.

Recommendation 24: Take advantage of international support for implementing recommendations

Support from international organizations, including from the EU through the Horizon 2020 Policy Support Facility, the World Bank and OECD, should be requested and used for implementing several of the recommendations outlined in the review.

This concerns in particular support for building-up capacity for R&I policy making in Moldovan Ministries, for implementing the National R&I funding agency, for improving R&I statistics, for assessing the existing innovation infrastructure.

Support from the EU can be provided e.g. via the H2020 Policy Support Facility (PSF), the TAIEX instrument (for financing experts), the technical assistance from ESIF (European Structural and Investment Funds), the new Structural Reform Support Service (SRSS) to develop administrative capacity, the EU delegation, or from specific EU member states.

ANNEX 1. LIST OF DOCUMENTS RECEIVED AND STUDIED BY THE PANEL

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ANNEX 2. TENTATIVE IMPLEMENTATION ROADMAP OF THE RECOMMENDATIONS

Recommendations	Primary Stakeholders to uptake the recommendations					
	Ministry of Edu.	Line Ministries	Parliament	ASM	Research Community	Private Sector
Implementation suitable/feasible at Short-term						
1. Better embed R&I policy in the overall economic policy strategy	✓	✓	✓			
3. Establish a Ministerial responsibility for R&I policy-making and strategy development	✓	✓	✓			
7. Establishing an independent R&I Agency under a Ministry(ies)	✓	✓	✓	✓	✓	
8. Concentrate all available R&I funding under a single R&I funding entity	✓	✓	✓			
13. Safeguard the public R&I capacity	✓	✓	✓	✓	✓	
17. Build on Moldova's successful efforts to increase its integration in the ERA	✓	✓		✓	✓	✓
18. Improving the framework conditions for business innovativeness	✓	✓	✓	✓		
20. Invite business representatives to Management or Advisory Boards of HEIs and PROs, as well as to the Board of the proposed R&I Agency	✓	✓	✓	✓	✓	✓
24. Take advantage of international support for implementing recommendations	✓	✓		✓		
Implementation suitable/feasible at Medium-term						
2. Strengthening the public perception of the role of R&I	✓	✓	✓	✓	✓	
5. Focus R&I priorities on a limited set	✓	✓	✓	✓	✓	✓
6. Improve the system to collect and process R&I statistics	✓	✓				
9. Increasing the share of the competitive funding for R&I	✓	✓		✓	✓	
10. Increasing the R&I intensity	✓	✓	✓	✓	✓	✓
11. Incentives for cooperation and mobility between research institutes and universities	✓			✓	✓	
12. Introduction of systematic evaluation procedures for PROs and HEIs	✓	✓		✓	✓	
14. Improve the employment and funding opportunities, the working conditions and the career perspectives of public researchers	✓	✓		✓	✓	
15. Reinforce the recruitment, promotion and career opportunities through open and merit-based recruitment procedures	✓	✓	✓	✓	✓	
16. Create incentives for rewarding researchers' careers through better salary rewards	✓	✓	✓	✓		
19. Increasing support measures to foster business R&D engagement	✓	✓		✓		✓
21. Encourage business to academia mobility and traineeships in companies	✓	✓		✓	✓	✓
22. Improving innovation capabilities of PROs	✓	✓		✓	✓	✓
23. Assess the national schemes in support of innovation infrastructures		✓		✓	✓	✓

ANNEX 3. QUALITATIVE IMPACT ASSESSMENT TABLE OF THE RECOMMENDATIONS

Recommendation	Impact on:							
	National Research performance	Human Resources for Research	Innovation potential	Strengthen participation in FP7/H2020	Addressing Societal Challenges	Public Awareness / Culture of STI	Employment (general)	Growth
Increasing R&I impact								
1. Better embed R&I policy in the overall economic policy strategy	High	Medium	High	Low	Medium	Low	Medium	High
2. Strengthening the public perception of the role of R&I	Medium	High	Medium	Low	Low	High	Low	Low
3. Establish a Ministerial responsibility for R&I policy-making and strategy development	High	Medium	High	Medium	Medium	Medium	Low	Low
4. Panel is not convinced of an added value of an inter-ministerial Council for R&I	Low	Low	Medium	Low	Low	Medium	Low	Low
5. Focus R&I priorities on a limited set	High	Medium	High	Medium	Medium	Low	Medium	Medium
6. Improve the system to collect and process R&I statistics	Medium	Low	Medium	Low	Low	Low	Low	Medium
Increasing the efficiency of the R&I performing bodies and instruments, and of the public R&I funding								
7. Establishing an independent R&I Agency under a Ministry(ies)	High	Medium	High	Medium	Medium	Medium	Low	Low
8. Concentrate all available R&I funding under a single R&I funding entity	High	Medium	High	Medium	Medium	Medium	Low	Low
9. Increasing the share of the competitive funding for R&I	High	Medium	High	Medium	Medium	Low	Low	Medium
10. Increasing the R&I intensity	High	High	High	Medium	High	Medium	Medium	High
Improving Human Resources and mobility of researchers								
11. Incentives for cooperation and mobility between research institutes and universities	High	High	Medium	Low	Low	Medium	Low	Low
12. Introduction of systematic evaluation procedures for PROs and HEIs	High	High	Medium	Medium	Medium	Low	Low	Low
13. Safeguard the public R&I capacity	High	High	Medium	Medium	Low	Low	Low	Low
14. Improve the employment and funding opportunities, the working conditions and the career perspectives of public researchers	High	High	Medium	Medium	Medium	Medium	Medium	Low
15. Reinforce the recruitment, promotion and career opportunities through open and merit-based recruitment procedures	High	High	Medium	Medium	Low	Low	Medium	Low
16. Create incentives for rewarding researchers' careers through better salary rewards	Medium	High	Medium	Medium	Low	High	Low	Low
17. Build on Moldova's successful efforts to increase its integration in the ERA	High	Medium	Medium	High	Medium	Medium	Low	Medium
Boosting business innovativeness and science-business links								
18. Improving the framework conditions for business innovativeness	High	Medium	High	Medium	Low	Low	Low	Medium
19. Increasing support measures to foster business R&D engagement	High	Low	High	Low	Medium	Medium	Medium	Medium
20. Invite business representatives to Management or Advisory Boards of HEIs and PROs, as well as to the Board of the proposed R&I Agency	Medium	Medium	High	Low	Medium	Medium	Low	Medium
21. Encourage business to academia mobility and traineeships in companies	High	High	High	Low	Low	Medium	High	Medium
22. Improving innovation capabilities of PROs	Medium	Low	High	Medium	Low	Low	Medium	Medium
23. Assess the national schemes in support of innovation infrastructures	Medium	Low	High	Low	Low	Low	Low	Medium
Conclusions								
24. Take advantage of international support for implementing recommendations	High	Medium	Medium	Medium	Low	Low	Low	Low

ANNEX 4. R&D STRATEGY OF THE REPUBLIC OF MOLDOVA 2014-2020: KEY ELEMENTS

The Moldovan R&D Strategy has the aim to create a stimulating environment for R&D and innovation activities in Moldova. It defines challenges for the period 2014-2020, based on a state of play and SWOT analysis. It includes a detailed Action Plan on measures for its implementation.

Five general reform objectives were defined. To achieve those a large number of specific objectives and measures are proposed in the Strategy:

1. Governing the R&D sector based on a consensual model, and focused on performance and excellence. Specific issues/ measures concern: improving funding methods and instruments; establishing equal conditions for public and private research performers for access to R&D funding; simplifying the reporting procedures and reducing bureaucracy; improving submission and evaluation procedures of R&D projects; using at least 50% foreign evaluators for project evaluations; allocating institutional funding based on evaluation; ensuring autonomy and self-governance of the R&D sector.
2. Developing human, institutional and infrastructure capacities. Specific issues/ measures concern: investing in young talent (increasing wages) and creating a well trained human capital according to international standards; strengthening the collaboration between education and research by promoting joint projects at national and international level, and by organizing joint doctoral schools; making appropriate research infrastructure available and establishing national technology platforms in fields of major importance for economy and/or society; modernizing curricula and involving the private sector to this end; using financial and tax incentives for stimulating R&D in the private sector.
3. Defining and managing research priorities. Specific issues/ measures concern: selecting priorities that are consistent with societal needs, international trends and the research capacity at national level; focusing resources on the agreed priorities and goals; fostering the dialogue on the priorities with the main stakeholders; orienting the strategic R&D fields along the six key lines in the Horizon 2020 EU Sectoral Strategy; delegating the implementation of the R&D state policy from the Government to the National Research and Development Agency for at least 4 years.
4. Ensuring permanent dialogue between science and society, disseminating knowledge and implementation of the research results. Specific issues/ measures concern: developing platforms for continuous dialogue with various stakeholders and society at large; organizing debates on societal challenges to identify needs and problems that need to be settled; developing instruments to transfer scientific knowledge to society and to facilitate implementation of results; establishing an industrial PhD; continuing the support of technological parks and innovation incubators to facilitate the implementation of research results; developing partnerships with SME's; fostering intellectual property rights and research results; improving R&D statistics.
5. Internationalizing research, ensuring integration in the European Research Area and enhancing international visibility. Specific issues/ measures concern: associating to the EU's Horizon 2020 Programme and disseminating information on the program; developing support instruments for international research cooperation; supporting mobility of researchers from abroad to the national research system; initiating cooperation with pan-European research centers; attracting the Moldovan scientific diaspora to R&D activities in the country; commercializing research results on the international market.

The Strategy is foreseen to be monitored and evaluated against performance and output indicators and to get adjusted after an external independent evaluation halfway through its implementation.

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The Horizon 2020 Policy Support Facility (PSF) has been set up by the Directorate-General for Research & Innovation (DG RTD) of the European Commission under the EU Framework Programme for Research & Innovation 'Horizon 2020'.

It supports Member States and countries associated to Horizon 2020 in reforming their national science, technology and innovation systems.

The Peer Review of the Moldovan Research and Innovation system at the basis of this report was carried out between November 2015 and May 2016 by a dedicated PSF panel, consisting of seven independent experts and national peers. The Moldovan national authorities expressed strong political commitment to this exercise.

The PSF panel arrived at a compact set of Policy Messages highlighted upfront in the report, which contains the rationale supporting each of those policy statements and discusses the 24 specific recommendations proposed by the panel, clustered into thematic areas.

Case studies from other countries supplement the narrative by presenting good practice that could facilitate the operational implementation of the panel recommendations.