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The opinions expressed are those of the authors only and should not be considered as representative of the European Commission's official position.

Executive Summary

Croatia is a small country of 4.4 million inhabitants that account for less than 0.9% of the population of the EU-27. The accession negotiations for the Croatian membership in the European Union (EU) that have begun in 2005 have a prospect to be completed in 2011.

The Croatian economy is one of the most developed in south-eastern Europe recording relatively stable growth path since 2000. According to Eurostat it has reached €10,683 in 2008 or 63% of GDP of the EU-27 average. However, the Croatian economy has been affected by the global financial and economic crisis which was severely deepened by the fall in domestic demand, personal consumption and investments. Real GDP declined by 5.8% in 2009 while unemployment rate climbed to 16.7% at end of 2009, compared to 13.5% a year before.

Although Croatian research sector has evolved considerably in the last 20 years the Croatian scientific community has 2,500 researchers per million inhabitants, which is only 57% of the EU-27 average, which has about 4,300 researchers per million inhabitants. Particularly worrying is the small share of researchers (head count) of the business sector that is only 22% of the EU average (0.14% in Croatia versus 0.62% in the EU-27).

The investments in R&D culminated in 2004 when the gross domestic expenditure on research and development (GERD) reached 1.05% of GDP. After a sharp decline to 0.76% of GDP in 2006 (€300.6m), it has been showing a trend of slight recovery in the next couple of years reaching 0.9% of GDP (€421m) in 2008. That is considerably below the average of the EU-27 (1.9% of GDP). According to the Central Bureau of Statistics, the financial and economic crisis reduced the R&D expenditure again in 2009 to 0.83% of GDP (€383m). However, Croatia remains the leader in scientific research in the region of Southeast Europe.

The public resources for R&D in 2009 (HRK 1.4b or €196m) has slightly decreased compared to 2008 (HRK1.5b or €208m) and amounted to 0.43% of GDP which is far from the Lisbon target of 1% of GDP of public resources for R&D. The private sector investments in R&D have also decreased in comparison to the previous year both in absolute terms (from €186m to €155m) and in relative terms (from 44.2% of GERD in 2008 to 40.4% of GERD in 2009), whereas its total investments in R&D amounted to 0.34% of GDP (0.40% in 2008).

The public R&D sector, with universities playing a leading role, is the largely dominant sector in both research manpower (80% of total researchers) and performing research activities (59% of R&D). As reported in 2009, the business sector employs a modest 20% of total researchers and invests 0.4% of GDP in R&D. This indicates a substantial lack of critical mass of researches and investments in the private sector for technological accumulation and transition to knowledge economy. The majority of GERD (51.1%) is financed by the government while business sector contributed with 40.0%. Another 6.9% comes from abroad (mainly for services of the business companies) and the rest is accounted for the higher education sector universities (1.9%) and private non-profit sector (0.1%).

In order to foster R&D in the business sector the Croatian government has developed rather complex policy mix to promote private investments in R&D that includes programmes of BICRO, HIT, UKF, MELE and fiscal measures (tax relief). However, the policy mix is in some cases underfunded and complex to utilise (e.g. direct subsidies). Moreover, the reaping of benefits of technology development is constrained by economic and financial instability, lack of investments, corruption, low technology level of the economy and unsatisfactory innovation performance of the business sector. Therefore, the main challenge is to envisage the more functional programmes with greater impact on economy and technology. A certain aspect can be perceived in establishing large-scale clustering programmes which would pull together the main stakeholders of the innovation system at regional or national level.

Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	<ul style="list-style-type: none"> • Reduced government funding for R&D and scholarships for PhD students; • Ensuring quality of research and scientific excellence of RTO and universities (Action plan, 2009); • Enhancing mobility of researchers (Action plan, 2010); • Three important laws: the Law on Science, the Law on Universities and the Law on Higher Education have been proposed in October 2010. 	<ul style="list-style-type: none"> • The main weakness is reduced GERD that hinder funding of research activities and scientific excellence; it could also direct researchers more towards European and international funds and contribute to the internationalisation of science; • The proposals of the laws foresee huge changes in functioning of the entire higher education and scientific system and although changes are needed, there is no consensus regarding the optimal path.
Innovation policy	<ul style="list-style-type: none"> • Orientation towards IPA IIc (Regional Competitiveness) measures like Science and Innovation Investment Fund (SIIF) and BIOCentre. 	<ul style="list-style-type: none"> • The orientation towards IPA regional development is an excellent instrument for better integration of RTO/universities into the local development and closer science-industry cooperation; the main threat is the lack of good project proposals and low involvement of local economy.
Education policy	<ul style="list-style-type: none"> • Participation of Croatia in the EU mobility programmes such as Marie Curie-People, EURAXESS and opening scholarships schemes for the Croatian under-graduate and graduate (doctoral) students via Scholarship fair and internet portal; participation of Croatia in the EU programmes of the lifelong learning. 	<ul style="list-style-type: none"> • Enlarged mobility helps the integration of the Croatian youth, researchers and teachers into EU and contributes to the supply of foreign researches and Diaspora to the Croatian RTO/universities; however it does not much influence general labour supply for researchers in business sector and does not influence the mismatch between enrolment quotas for education programmes with higher employability rates and distortions in the university-educated segment of the Croatian labour market towards SSH.
Other policies	<ul style="list-style-type: none"> • Law on Regional Development; • Strategy on Regional Development. 	<ul style="list-style-type: none"> • The framework of regional development has been defined, which should facilitate competitiveness-enhancing activities (including research), but the framework for funding of regional projects has not been redefined yet.

European Research Area

The Science and Technology Policy 2006-2010 recognised the participation of the Croatian researchers in the ERA as one of the national priorities related to technological development and transition into the knowledge economy. Since 1 June 2006 when Croatia acquired full membership in the ERA the progress in biotechnology, new synthetic materials and nanotechnologies have been incorporated into the national research policy priorities.

It should be stated that participation in FP still has not produced the structural effects in the science policy in terms of thematic organisation of research programmes, setting up research priorities or financing research projects. Science policy remains mainly generic by character and emphasises horizontal support measures aimed at all research disciplines while thematic priorities of wider national or European interest like biotechnology, climate change, clean energy, ageing, etc. do not yet formed the thematic research programmes.

The European funding remains also a minor source of additional funds for R&D in Croatia. Within the FP7, a total of 137 Croatian partners have contracted 108 projects with the EC co-financing in the amount of €23.9m (mostly for "Cooperation"). According to CBS data, the share of resources from EC for research activities decreased from 4.3% in 2008 to 3.1% in 2009 of total funds from abroad. Since it is estimated that success rate of projects that involved Croatian partner in FP7 is rather low, the analytical study on the performance of the Croatian participation in FP7 is under way. The emphasis is on the analysis of unsuccessful projects to identify the reasons why projects failed the evaluation. Increasing the participation of the Croatian researchers into the ERA remains a main challenge.

Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	The Croatian Agency for Mobility and EU Programmes has been established in 2007 to take care about mobility with a view of a single EU labour market; the Action plan for overcoming obstacles and enhancing the international mobility in education for the period 2010-2012 was adopted in September 2010; Croatia has become a member of the EU programme for life-long learning on December 7, 2010.	The Agency, the Action plan and the official inclusion of Croatia in the EU LLL should significantly improve circulation of youth, researchers and teachers between Croatia and EU and contribute to the single EU labour market.
2	Increase public support for research	Action plan 2007-2010 set up a target to increase R&D funding in both the private and public sectors at a rate of at least 25% annually. The goal is to reach a 1:1 ratio of public vs. private sector investment in R&D by 2010.	In reality, the financial and economic crisis reduced the R&D expenditure from 0.9% of GDP in 2008 to 0.83% of GDP in 2009.
3	Increase European coordination and integration of research funding	Croatia is active participant in the joint funds of the SEE-ERA.NET PLUS programme aimed at integrating EU Member States and Southeast European countries in the ERA.	The threat is the lack of national resources for continuation and expansion of such common funds.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
4	Enhance research capacity across Europe	The participation of Croatian researchers in FP7 is increasing. National contact points (NCPs) are providing support in this regard.	Increasing the participation of the Croatian researchers into the ERA remains the key challenge.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	The investments into research infrastructure have become the key component of EU funding in Croatia (through the Regional Competitiveness Operational Programme).	Because of the lack of funds and administrative obstacles, the projects often take a long time to develop
6	Strengthen research institutions, including notably universities	Due to the harmonisation with the Bologna process all the study programmes were reviewed in 2005; the Law on quality assurance in science and higher education system has been enacted in April 2009 (OG 45/2009). A system of internal and external evaluation of research at RTO and universities has been established by the ASHE as the pillar institution of the national system of quality assurance of research system in Croatia. Three universities (out of seven) have quality assurance offices (Zagreb, Rijeka, Split).	The results of evaluation are yet not used a base for institutional funding. Instead, the present criteria for institutional funding are rather formal and include a number of researchers and their scientific coefficients.
7	Improve framework conditions for private investment in R&D	The Action Plan to encourage investments in science and research set up targets of 15% annual increase of BERD and 20% annual increase of value of R&D contracts between science and industry. Tax incentives provide support to private R&D.	Overall business climate for private R&D investments is unfavourable. The resources of domestic companies are limited, and R&D-intensive FDI have not been attracted.
8	Promote public-private cooperation and knowledge transfer	The key instruments include joint research projects and industrial PhD research.	The level of cooperation is low and is still hindered by administrative restrictions, lack of joint projects and underdeveloped academic entrepreneurship.
9	Enhance knowledge circulation across Europe and beyond	There are basically two large programmes open to foreign researchers the "Brain gain" programme of the NZZ and UKF programmes that enhance circulation of researchers/knowledge.	The main challenge is to intensify and accelerate the implementation of a number of measures for facilitating inflow of researchers which are under way, such as regulation on temporary residence, health insurance, social security, etc.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	International science cooperation is primarily facilitated by bilateral agreements.	Due to limited funds, research cooperation is mostly limited to Europe.

	ERA objectives	Main national policy changes	Assessment of strengths and weaknesses
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	The Strategic Council for Science and Technology (SVEZNATE) and the National Innovation System Council of MSES (VNIS) has been established to coordinate activities between different ministries involved into the knowledge triangle.	SVEZNATE and VNIS are not fully operational while a number of government bodies and funding agencies lack mutual coordination. The entire strategy of research and technological development remains rather undefined.
12	Develop and sustain excellence and overall quality of European research	Quality assurance mechanisms are being put in place.	Structural problems of the research sector hinder the overall quality of research.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	Industrial and regional policies have been defined; Trade and Investment Promotion Agency was closed down in 2010.	Industrial policy is not transparent; regional policy is not supported by adequate funding mechanisms; FDI attraction does not address the need to specialise towards more knowledge-intensive activities.
14	Mobilise research to address major societal challenges and contribute to sustainable development	The global challenges related to the fresh and sea waters, soil, agriculture, air and climate change are addressed in Croatia by Croatian Environment Agency . Ageing of the society is tackled by demographic studies and studies related to pension system reforms. The new Energy Strategy adopted in June 2009 recognised the EU climate and energy targets by 2020, known as the "20-20-20" targets.	There is a lack of specialised research programmes aimed at addressing major national and global societal changes.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	The evaluation and accountability culture of the Croatian science and innovation policy is rather modest. The most influential actors on building the trusts are public media which communicate knowledge achievements to wider public.	A long term strategy for supporting mechanisms to build mutual trust between science and society does not exist in Croatia. The impact studies of science and innovation policy programmes on economic development are missing.

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1 Introduction

The main objective of the ERAWATCH Analytical Country Reports 2010 is to characterise and assess the evolution of the national policy mixes in the perspective of the Lisbon goals and of the 2020, post-Lisbon Strategy. The assessment will focus on the national R&D investments targets, the efficiency and effectiveness of national policies and investments into R&D, the articulation between research, education and innovation, and on the realisation and better governance of ERA. In doing this, the 15 objectives of the ERA 2020 are articulated.

The report builds on the 2009 report streamlining the structure and updating the 2009 policy assessment in the domains of human resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. The information related to the four ERA pillars covered in the 2009 report is also updated and it is extended in order to cover all six ERA pillars and address the corresponding objectives derived from ERA 2020 Vision.

Given the latest developments, the 2010 Country Report has a stronger focus on the link between research and innovation, reflecting the increased focus of innovation in the policy agenda. The report is not aimed to cover innovation per se, but rather the '**interlinkage**' between research and innovation, in terms of their wider governance and policy mix.

2 Performance of the national research and innovation system and assessment of recent policy changes

The aim of this chapter is to assess the performance of the national research system, the '**interlinkages**' between research and innovation systems, in terms of their wider governance and policy and the changes that have occurred in 2009 and 2010 in national policy mixes in the perspective of the Lisbon goals. The analysis builds upon elements in the ERAWATCH Country Report 2009, by updating and extending the 2009 policy assessment in the domains of resource mobilisation, knowledge demand, knowledge production and science-industry knowledge circulation. Each section identifies the main societal challenges addressed by the national research and innovation system and assesses the policy measures that address these challenges. The relevant objectives derived from ERA 2020 Vision are articulated in the assessment.

2.1 Structure of the national research and innovation system and its governance

Croatia is a small country of 4.4 million inhabitants that account for less than 0.9% of the population of the EU-27. The accession negotiations for the Croatian membership in the European Union (EU) that have begun in 2005 have a prospect to be completed in 2011.

The Croatian economy is the most developed in Southeast Europe, recording relatively stable growth path since 2000. According to Eurostat it has reached

€10,683 in 2008 or 63% of GDP of the EU-27 average. However, the Croatian economy has been affected by the global financial and economic crisis which was severely deepened by the fall in domestic demand, personal consumption and investments. Real GDP declined by 5.8% in 2009 while unemployment rate climbed to 16.7% at end of 2009, compared to 13.5% a year before.

Although Croatian research sector has evolved considerably in the last 20 years the Croatian scientific community has 2,500 researchers per million inhabitants, which is only 57% average in the EU-27, which has about 4,300 researchers per million inhabitants. Particularly worrisome is a small share of researchers (head count) of the business sector that is only 22% of the EU average (0.14% in Croatia versus 0.62% in the EU-27).

Main research performer groups

The public R&D sector, with universities playing a leading role, is the largely dominant sector in both research manpower (80% of total researchers) and performing research activities (59% of R&D). As reported by the Central Bureau of Statistics in 2009, majority of GERD (51.1%) is financed by the government while business sector contributed with the 40.0%. Another 6.9% comes from abroad (mainly for services of the business companies) and the rest is accounted for by universities (1.9%) and private non-profit sector (0.1%).

The public research sector consists of seven universities, 14 public and 18 private polytechnic and professional higher education institutions, three academies and 26 public institutes. It also includes about fifty "other" public research institutions such as the Croatian Academy of Arts and Sciences or research units within health care institutions.

The business research sector includes 13 private scientific institutions, six of which are in-house institutes affiliated with large industrial corporations while remaining are research institutes which operate independently in the market. The majority of business research is financed by business companies themselves (86% in 2009) while the government accounts for a modest 2.1%.

Main actors and institutions in research governance

The governance structure of research and innovation is a complex system that consists of the four layers (see Figure 1):

- High policy level that includes Parliament Committee for Education, Science and Culture and the Ministry of Science, Education and Sports (MSES) (responsible for the overall functioning of the science and education system), the Strategic Council for Science and Technology (SVEZNATE) and the National Innovation System Council of MSES (VNIS);
- Policy formulation and implementation include the National Council for Science (NCS) and the National Council for Higher Education (NCHE) which are the highest advisory bodies in their respective fields; the Science and Higher Education Funding Council (SHEFC) which provide assistance for both the councils; the Agency for Science and Higher Education (ASHE) which is responsible for setting up a national network for quality assurance in science and higher education and for the National ENIC/NARIC Office;
- Administrative and evaluation bodies include the bodies for assessment and monitoring of the scientific projects and programmes financed by the MSES and

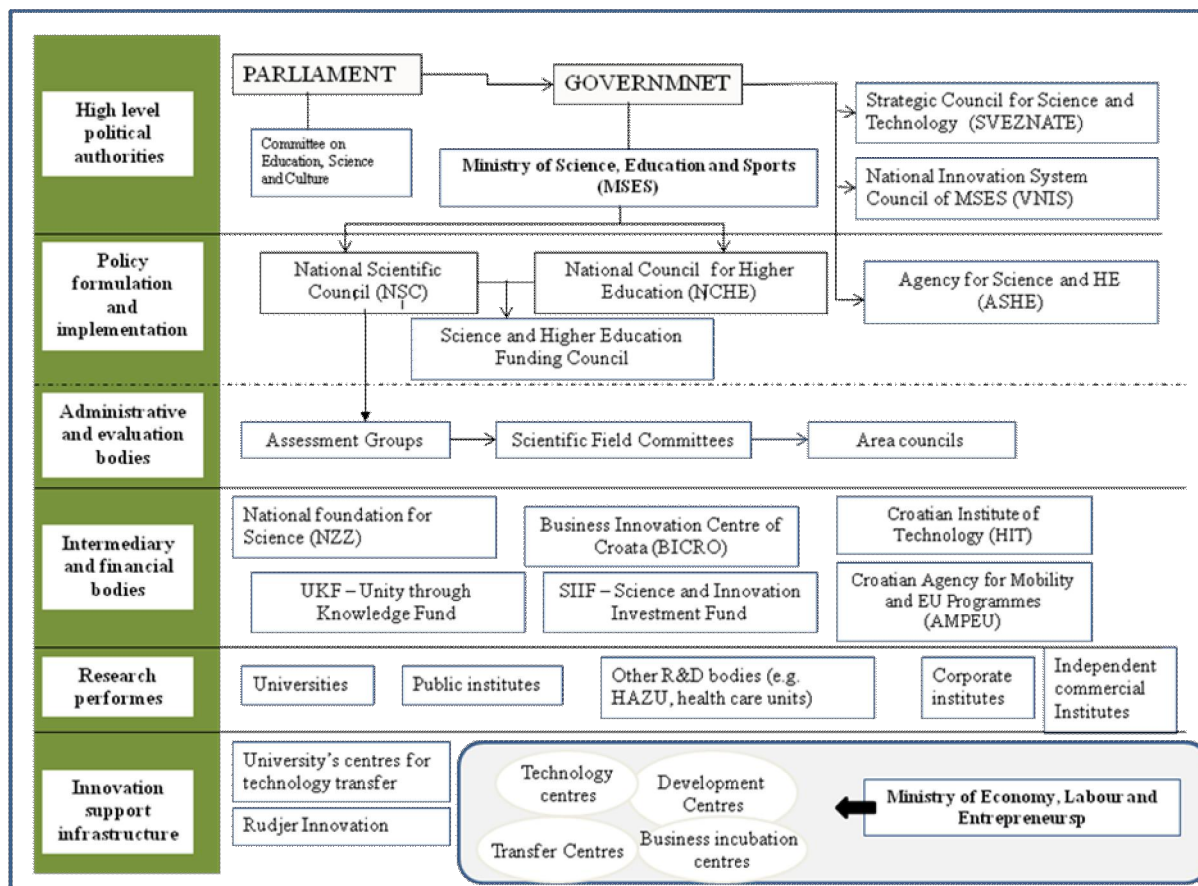
include six scientific fields which rely upon the recommendations of a number of assessment groups and area councils;

- Intermediary and financial bodies which include the National Foundation for Science (NZZ), the Business Innovation Centre of Croatia (BICRO Ltd.), the Croatian Institute for Technology (HIT Ltd), the Unity Through Knowledge Fund (UKF), the Croatian Agency for Mobility and EU Programmes (AMPEU) and the Science and Innovation Investment Fund (SIIF).

A substantive part of the innovation system related to entrepreneurship and business infrastructure development (supporting entrepreneurial zones, incubation centres, business centres and regional development agencies) rests within the Ministry of Economy, Labour and Entrepreneurship (MELE).

The short overview of the governance structure reveals that Croatia has a rather complex research and innovation system that consists of various institutions and programmes. However, some of the highest policy-making institutions in charge of strategic development (e.g. SVEZNATE, VNIS) are not fully operational while a number of government bodies and funding agencies lack mutual coordination. It does not create only rivalry among the public institutions and programmes but also leads to a lack of synergy and efficiency of the public policies. The entire strategy of research and technological development remains rather undefined and vague, illustrating that policy has not yet succeeded in defining priority areas and sectors that could be a key drivers of growth.

Figure 1: Overview of the Croatian research system governance structure



Source: ERAWATCH Research Inventory

The institutional role of regions in research governance

An explicit regional research policy does not exist in Croatia. The role of science and research as vehicles of regional development has not been articulated. Regional development policy exists mainly at the county (NUTS 3) level and is related to the affairs of regional significance such as regional economic development, traffic infrastructure, education, etc. Development perspectives of these regions are mainly defined by their natural resources and historical heritage. Some regions of Croatia, especially so-called areas of special state concern, suffer a lack of entrepreneurial capacity and infrastructure, insufficient social reintegration and economic rehabilitation and depopulation. These are largely areas that have been severely affected by the Homeland War (1990-1995) for independence from the ex-Yugoslavia such as Vukovar-Srijem or Brod-Posavina counties. The lack of regional research policy stems primarily from the insufficient development funds (due to the small tax base) to support education and research institutions and activities. The greatest impetus to regional development is provided by the pre-structural funds of the EU - the Instrument for Pre-Accession Assistance (IPA), Component III - Regional Competitiveness which is mainly focused on the development of entrepreneurship, innovation and sector of SME.

2.2 Resource mobilisation

Since 2000, Europe has made evident progress towards ERA but at the same time it is clear that Europe's overall position in research has not improved, especially regarding R&D intensity, which remains too low. The lower R&D spending in the EU is mainly a result of lower levels of private investment. Europe needs to focus on the impact and composition of research spending and to improve the conditions for private sector R&D investments.

This section assesses the progress towards national R&D targets, with particular focus on private R&D and of recent policy measures and governance changes and the status of key existing measures, taking into account recent government budget data. The need for adequate human resources for R&D has been identified as a key challenge since the launch of the Lisbon Strategy in 2000. Hence, the assessment includes also the human resources for R&D. Main assessment criteria are the degree of compliance with national targets and the coherence of policy objectives and policy instruments.

2.2.1 Resource provision for research activities

The Croatian gross domestic expenditure on research and development (GERD) has risen steadily since the mid 1990s and culminated in 2004 when it reached 1.05% of GDP. After a sharp decline to 0.76% of GDP in 2006 (€300.6m), it has been showing a trend of slight recovery in the next couple of years (2007 - 0.81% GDP (€349.8m); 2008 - 0.9% of GDP (€421m). That is considerably below the average of the EU-27 (1.9% of GDP) According to the Central Bureau of Statistics, the financial and economic crisis reduced the R&D expenditure again in 2009 to 0.84% of GDP (€383m).

The public resources for R&D in 2009 (HRK 1.4b or €196m) has slightly decreased compared to 2008 (HRK1.5b or €208m) and amounted to 0.43% of GDP which is far from the Lisbon target of 1% of GDP of public resources for R&D. The business

sector also has reduced their investments in R&D from HRK1.25b or €172m in 2008 to HRK1.1b or €152m in 2009 and amounted to only 0.34% of GDP.

Table 1: Croatian Gross Expenditure on Research and Development, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
EU-27	1.86%	1.83%	1.82	1.85%	1.85%	1.92%	2.01%
Croatia	0.97%	1.05%	0.87%	0.76%	0.81%	0.9%	0.84%

Croatia, as an EU candidate country, is not obliged to produce a National Reform Programme and related multi-annual R&D strategy. Instead, the Strategic Development Framework 2006–2013 is the main strategic document for the overall development which has recognised, among the ten priority areas, a prominent role of knowledge, education, science and information technology.

The science budget is set up on an annual basis in the framework of the State budget plan. The inflow of resources was relatively stable up to now, but have, however the tendency is to shrink since 2005. Due to the economic recession and declining of budget revenues, the scientists in Croatia have experienced in the last seven months several serious budget cutbacks. Since June 2010, the Ministry reduced the financial means for the operational costs of the scientific projects by about 10%. It also stopped for the time being financing of the PhD scholarships of the junior researchers which put the operational costs of the research projects under a serious financial pressure. The MSES has proposed and released into the public debate in October 2010 three laws with the intention to reform higher education and research system: the Law on Science, the Law on Universities and the Law on Higher Education. The laws would bring not only huge changes in the overall system but also supports further shrinking of the budget resources for R&D. They resulted in a strong opposition of all the stakeholders, which claim that the proposals are inconsistent and incoherent and that they would confer far too much power to politicians over science.

The strategic research policy goals were stated five years ago (in 2006) in the Science and Technology Policy 2006-2010 and the related Action Plan 2007-2010. It recognises the research priorities in biotechnology, new synthetic materials and nanotechnologies as well as in the nation-specific research themes such as understanding of humanity and national identity or preservation of natural wealth and cultural heritage. The financial predictions (3% of GDP for R&D; 1:1 ratio of public vs. private sector investment, etc.) are mainly understood as the motivational factors than realistic strategic goals.

The research policy in Croatia is mainly horizontal i.e. focused on the harmonised development of the all research disciplines. Within the given policy context, the majority of public resources are allocated by the Ministry of Science, Education and Sports (MSES) which employs four basic instruments to finance research:

- Institutional funding (block grant), including salaries for researchers (33%);
- Research grants for operational costs of research projects (competition-based programme), "Research Projects" programme (10%);
- Grants for new employment positions for young researchers through the competition-based "Junior Research Programme" (31.4%);

- Research-supporting programmes such as scientific Publishing Activity, Support for Scientific and Professional Conferences and Associations and Research Equipment (around 8.8%).

As reported by the Ministry of Finance, the total budget for R&D of the MSES in 2009 amounted to €135m that makes 0.84% of the State budget or 0.3% of the GDP.

In addition to the funds provided by the MSES, the researchers can apply to the additional four specialised intermediary/funding institutions which also provide the competition-based grants for research and innovation projects;

1. [The National Foundation of Science](#) (NZZ) (€5.2m in the period 2005-2008 for various programmes);
2. [The Croatian Institute of Technology](#) (HIT) (€30m in the period 2001-2009 for the TEST programme);
3. [The Business Innovation Centre of Croatia](#) (BICRO) (€3.8m in 2009 for various programmes);
4. [Unity through Knowledge Fund](#) (UKF) (€8.7m in the period 2006 – 2009 for various programmes).

Budget resources provided by the MSES usually make 80% to 85% of total research funding at public research institutes. Due to the lack of data, it is difficult to calculate the ratio between institutional and competition-based project funding. Generally speaking 70% of the allocated budget resources are spent on salaries, 10% on direct institutional funding (overheads, phone, energy, etc.), 10% on research grants (material and operational costs) and remaining 10% is spent on other research-supporting activities (conferences, publishing, etc).

In terms of GBAORD, the estimated data for 2009 report that the majority of GBAORD (44.6%) is allocated for the salaries of the teaching staff at higher education institutions and polytechnics, 29% is allocated for the various research activities (research project grants, equipment, IPA programmes, junior researchers, etc.) and 17% is spent for institutional funding of RTO mainly for salaries of researchers. Only 4.3% is allocated for technological projects (including the World Bank loan) and 3.2% for international research cooperation.

The subsidies to research and business sector are provided through the different programmes carried out by BICRO and HIT (e.g. TEST programme, RAZUM programme, IRCRO programme, venture capital programme, etc), but the resources are limited. When it comes to tax incentives, one of the most efficient tax incentives is the return of VAT paid for procurement of research equipment. It is estimated that around €7.2m was provided by the return of VAT in the period 2003-2005. The financial crisis brought a revocation of most tax incentives to companies. The incentives for R&D have been preserved through their inclusion in the Law on Science and Higher Education. Policy measures include the tax incentives for subjects of the Law on Profit Tax – based on eligible project costs. The highest incentives can be received by small companies undertaking basic research. As one moves towards medium-sized and large companies, and towards applied research, and development, the incentives are reduced. However, the definitions of all these categories are rather vague and it is likely that some companies take advantage of that. Namely, several large business R&D performers claim tax incentives that exceed the overall public R&D subsidies. Evidence can be found in corporate financial reports. However, the data on R&D-related tax incentives is neither

aggregated nor collected in a way that would enable comparison with R&D data collected by the Central Bureau of Statistics.

Croatia is, as an EU candidate country, eligible for the Instrument for Pre-Accession Assistance (IPA) launched in Croatia in 2007. The Component IIIc of the IPA (Regional Competitiveness Operational Programme) provides a room for participation of research organisations in regional development through the Science and Innovation Investment Fund (SIIF) and incubation centre for bioscience technologies (BIOCentre). The total envisaged budget for SIIF in the period 2009-2013 is €5m (€2,624.706m is already contracted) while the total value of the BIOCentre project is close to €18m.

A long-term strategy for supporting mechanisms to build mutual trust between science and society does not exist in Croatia. Unfortunately, the mutual trust between science and society seems to be disturbed in a last couple of years mainly due to the corruption affairs at universities. It calls for re-establishing the mutual trust between research community and society.

The data on resource allocations for the grand national and global societal challenges are not fully available. The research on these topics is incorporated within the 2,500 projects financed by the MSES for which data are available at the aggregate level for the six research fields. In order to acquire distribution across societal challenges would require access to data on each individual project.

However, the global challenges related to the fresh and sea waters, soil, agriculture, air and climate change are addressed in Croatia by [Croatian Environment Agency](#). The ageing of the society is a topic of many projects related to demographic studies and reforms of pension system. The new Energy Strategy of Croatia adopted in June 2009 fully recognised the EU climate and energy targets by 2020, known as the "20-20-20" targets¹.

2.2.2 Evolution of national policy mix geared towards the national R&D investment targets

The business sector investment in R&D (BERD) in Croatia remains significantly low and ranges from a maximum of 0.44% of GDP in 2004 to a minimum of 0.28% of GDP in 2006 that is far from the Lisbon goal of 2% of GDP for R&D from the private sector. In 2009, the business sector investments in R&D have also decreased in comparison to the previous year both in absolute terms (from €186m to €155m) and in relative terms (from 44.2% of GERD in 2008 to 40.4% of GERD in 2009), whereas its total investments in R&D amounted to 0.34% of GDP (0.40% in 2008). The public R&D sector largely surpasses the technologically weak private sector not only in terms of R&D expenditures but also in terms of the research workforce since the private sector employs only 15-20% of researchers.

¹ In March 2007 the EU's leaders endorsed an integrated approach to climate and energy policy that aims to reduce greenhouse gas emissions for at least 20%, to enlarge the energy consumption that comes from renewable resources for 20% and to reduce primary energy use for 20% by improving energy efficiency, by around 2020.

Table 2: BERD, Croatia, 2003-2009

	2003	2004	2005	2006	2007	2008	2009
EU-27	1.18%	1.16%	1.15%	1.17%	1.18%	1.21%	1.25%
Croatia	0.38%	0.44%	0.36%	0.28%	0.33%	0.4%	0.34%

Almost all of the business R&D is performed by several large companies engaged in pharmaceuticals, telecommunication, agriculture and the food and beverages industries. That is far from being sufficient for the technology recovery of industry or service sectors and for catching up with more developed countries.

The policy mix for promoting private investments in R&D involves the following routes of support:

Route 1: Promoting the establishment of new indigenous R&D performing firms

This route has been primarily channelled via BICRO and HIT as the agencies responsible for implementation. BICRO has been managing two programmes since 2006, RAZUM and VENCRO. RAZUM project is oriented toward financing firm's seed capital. VENCRO programme was introduced in 2008 as a government initiative encouraging potential fund managers to start venture capital funds, but it has not yet been implemented due to low interest of private sector.

Route 2: Stimulating greater R&D investment in R&D performing firms

This route includes two basic programmes initiated in 2006 and organized by BICRO: IRCRO programme finances R&D investment in SMEs. The RAZUM programme is also intended for investing into the new product (or service) development in existing SMEs. MELE implements two programmes (Innovation and New Product and Strengthening of SME Competitiveness). The first programme scheme focuses on new product development. The second one supports process and product and services improvements within the national SME sector.

Route 3: Stimulating firms that do not perform R&D yet

The TEST programme supports pre-commercial research activities and the development of new product and/or processes up to the prototype point or pilot solutions and is aimed to both researchers and entrepreneurs who want to carry out research activities in cooperation with RTO/universities.

Route 4: Attracting R&D-performing firms from abroad

Over the past several years, attracting R&D performing firms from abroad has received little attention, but it is expected that this will change in the future, as some science-technology park projects are being developed.

Route 5: Increasing extramural R&D carried out in cooperation with the public sector

TEHCRO is the main policy instrument for finance and maintenance of science and technology parks, managed by BICRO. A similar (but underfunded) project, Technology Parks, was started by the MELE. National Foundation for Science (NZZ) carries out the programme - Partnership in Basic Research- aimed at increasing non-governmental investment in basic research.

Route 6: Increasing R&D in the public sector

In the last fourteen years the main achievement of the science and research sector was the significant increase in the number of young researchers employed, from 915 in 1996 to 2,510 in 2005. Institutional framework in science and research sector has significantly developed, but the public investments into R&D have not followed these developments.

As for the other policies that affect R&D investments, the situation is as follows. Framework conditions for private investment have worsened due to the economic crisis, and the government has not developed a comprehensive proactive response that could compensate for the reductions of economic activity and layoffs. The framework for setting up a business has been simplified but new investment projects often face significant administrative barriers. The administrative and tax burden on running a business has not been reduced. The government has attempted to reduce the cost of borrowing of private companies by new programmes introduced by the Croatian Bank for Reconstruction and Development, but with limited success. The costs of intellectual property rights protection are significant. The innovation oriented procurement policies do not exist in Croatia.

Comprehensive evaluation studies of the impact of these programmes on science-industry partnership and private investments in R&D are missing. However, the current weakness of the industrial research sector is extremely low investments in R&D (0.34% of GDP) with rather poor impact on technological development despite undertaken measures. In addition, according to the European innovation survey, Croatia is innovation laggard with a low national innovation capacity.

The main obstacles for increasing private investments in R&D are complex and involve not only economic and technological but also socio-cultural and political factors. The following obstacles are identified:

- The structure of the national economy is dominated by the low-tech sectors such as trade, real estate, construction, and similar sectors which do not depend on investments into R&D. For example, the largest share of gross value added (GVA) in 2007 was achieved in financial intermediation, real estate, renting and business activities (22.9%), followed by manufacturing sector (combined with sectors of mining and quarrying and electricity, gas and water supply) with the share of 20.4%, public administration, social and health security and education with 16.8% and trade (wholesale and retail trade; repair of motor vehicles motorcycles and personal and household goods) with 12.7%.
- The lack of structural reforms of technology obsolete sectors (e.g. shipyards, agriculture) that absorb huge state subsidies which could be otherwise used for innovation:
- Foreign-direct investments are local market oriented and exports are limited and focused on non-technological products;
- SME sector is technologically weak and companies are not interested in R&D due to their low technology capabilities and absorption capacities;
- There is a huge lack of research workforce in the private sector (number of researchers of the business sector is only 22% of the EU average (0.14% in Croatia versus 0.62% in the EU-27);

- The innovations are not motivating factor since the factors of success are perceived in political power and clientelism, not in personal achievements through entrepreneurship and innovation;
- There is a lack of development visions resulting in the shortage of the large scale programmes that would involve private business cooperation and stimulate their investments in R&D.

Although the policy mix is rather complex and diverse it has not provided the satisfactory level of private investment in R&D needed for an impact on economic and technological development. Therefore, more sound and large-scale programmes (e.g. clustering, technology platforms) should be put in place to join the forces of different stakeholders at regional or national level.

2.2.3 Providing qualified human resources

The national policy and goals for the provision of qualified human resources was not clearly established. Strategic goals related to the share of the higher educated labour force and PhDs are missing in the official policy and strategic documents. According to expert estimations (Lučin, 2007) Croatia should have at least 40% of the active population with a Higher education degree and at least 2% of them holding a PhD by the year 2025. The Education Sector Development Plan 2005-2010, adopted in May 2006, mentioned the target of 20% of persons with the tertiary degree by the year 2010.

According to the available data, the proportion of people with a postsecondary education degree in the active labour force (age 25-65) is rather low (15.2%), significantly below the average of the European Union. The figure on human resources in science and technology (HRST) as a percentage of labour force in Croatia was 31.6% in 2009 whereas in developed countries it often exceeds 50% (EU-27 – 40.1%). However, the trends are positive – in 2006, the corresponding indicator was at 29.2%.

The youth in Croatia is well-educated since over 95% of the population aged 20-24 completed some kind of upper secondary school while the average in the EU (EU27) is 79% as reported by the EUROSTAT. Croatia a leading country in youth education among European countries. The future of Croatia depends on establishing such a system which will enable these young people to complete higher education and use their skills in productive way. The problem is that the market for researchers in Croatia is rather underdeveloped mainly due to the lack of interest of the private business sector for R&D activities and services. It threatens a great number of PhD students to become unemployed if they will be forced to leave RTO or universities after PhD accomplishment. In the 10-year period of the programme, the number of young researchers employed as research/teaching assistants has increased significantly from 915 in 1996 to 2,510 in 2005 while between 2002 and 2009 3,090 new junior researchers have been hired.

That is the result of the Junior Researchers Programme carried out by the Ministry of Science, Education and Sports which is aimed at rejuvenation of the scientific community, the provision of a sufficient inflow of young researchers and the attracting of the interest of young people in pursuing a scientific career. It provides new employment positions for young researcher at institutes and universities as well as financial support for their training and education. The top 10% of undergraduate students can apply for this programme.

Yet, the number of new doctorate graduates per 1,000 population aged 25-34 was 0.8% in 2009, which is only 57% of EU average of 1.4%. However, the trends are positive. In 2007, the number of new doctorate graduates per 1,000 population aged 25-34 was 0.7%. The share of doctors of science in the population is very low and amounts to 0.25% of population while the target is to increase their share to 1% of population in the next 10 years. Total of 572 doctors of science graduated in 2009, with the average age of 38.1 years, while the modal group (with the highest frequency) consisted of persons aged 30 to 34.

The human resources development and market for researchers is also supported by the mobility programmes such as the "Brain Gain" which is managed by NZZ and the Unity through Knowledge Fund (UKF) programmes aimed at encouraging research cooperation and mobility between Croatia-based and expatriate Croatian scientists with the ultimate goal of motivating the expatriates to return home.

The Bologna process of harmonisation of the Croatian higher education sector with the EHEA is especially important for the development of the human resources and market for researchers. It put the foundations for the workforce inflow and outflow with the European Union. The most important policy actions include participation of Croatia in the EU mobility programmes such as Marie Curie-People, EURAXESS and opening scholarships schemes for the Croatian under-graduate and graduate (doctoral) students via Scholarship fair and internet portal organised by the Institute for the Development of Education. A prominent role has also the ENIC/NARIC office (qualification recognition) and the Agency for mobility and EU programmes (AMPEU), which is the national focal point for researchers' mobility within Europe.

The EU programmes of the **lifelong learning** (LLL) are carried out in Croatia since 2009 by the AMPEU which implement the following lifelong learning programmes (LLP): Comenius (pre-school and school education), Erasmus (higher education), Leonardo da Vinci (vocational education and training), Grundtvig (adult education) as well as Transversal Programme Jean Monnet programme (European integration in the area of LLL). The implementation of the LLP is additionally supported by the [Action plan](#) carried out by the MSES in September 2010 for overcoming obstacles and enhancing the international mobility in education for the period 2010-2012.

On the job-training is under the responsibility of the [Agency for Vocational Education and Training and Adult Education](#). One task of the Agency is to Reform and develop a modern vocational education and training (VET) system in Croatia is based on the [Vocational Education and Training System Development Strategy of the Republic of Croatia 2008-2013](#) and the Vocational Education and Training Act. On the other side the Agency, create conditions for the improvement of competitiveness of adult learners in the labour market in order to enhance their economic and social status. The majority of funds are coming from the IPA Component IV – Human Resources Development and previously from the CARDS programme. In order to reform education curricula by taking into account aspects such as creativity, critical thinking, or teamwork the [Croatian National Educational Standard](#) has been created and implement since 2005 in elementary schools. The entrepreneurship training is still not widely included in the curricula. At the level of university education, the initial steps are made within the TEMPUS project [FoSEntHE](#) focused on development of the teaching programmes for enterprises and entrepreneurship.

It is commonly perceived that the needs of the **labour market** are not systematically assessed by the university education. The rigidity of the HE system in terms of

adapting to the needs of the economy has been subjected to much criticism. There is large inertia in setting up enrolment quotas for programmes with higher employability rates, especially with respect to the portion of students financed by public resources. The entry quotas have not followed the changes in labour market demands but they were mostly the result of revenue maximization strategy, established by the faculty boards. The excessive quotas for courses in social sciences and humanities, coupled with emergence of new private schools offering similar course, created distortions in the university-educated segment of the labour market. About two thirds of students of private professional schools study social sciences and humanities (e.g. business management). At the same time, there is an alarming trend in declining of the share of young people who are taking up technical and natural sciences. Most university students in 2007 graduated in social sciences and humanities (almost 54%) while in 2000 the share of graduates in social sciences and humanities (SSH) was 10% lower. The number of graduates in natural sciences is extremely low while the number of graduates in technical and medical sciences is constantly decreasing since 2000.

The presented data illustrate that Croatia is missing the experts who are able to cope with the translation of research results and cutting-edge scientific advances into the new technologies and marketable products which threat overall development and competitiveness.

2.3 Knowledge demand

This section focuses on structure of knowledge demand drivers and analysis of recent policy changes.

Structure of knowledge demand drivers

The FDI in Croatia was reduced in 2009 below €3b (€2,128.6m), which is the lowest amount of FDI since 2005, when it was below €2b. The FDI was highest in wholesale trade and commission trade (NACE 51) where it reached €801m, or 37.63% of total FDI, followed by financial intermediation, except insurance and pension funds (NACE 65) with €656.2m or 30.83% and other business activities (NACE 74) with €304.8m or 14.32% in total FDI.

The project on the General Budget Appropriation and Outlays for R&D (GBAORD) was launched for the first time in Croatia in 2009. As stated in Chapter 2.2.1, the estimated data for 2009 report that the majority of GBAORD (44.6%) is allocated for the salaries of the teaching staff at higher education institutions and polytechnics, 29% is allocated for the various research activities (research project grants, equipment, IPA programmes, junior researchers, etc.) and 17% is spent for institutional funding of RTO. Only 4.3% is allocated for technological projects (including the World Bank loan) and 3.2% for international research cooperation.

After a period of recovery (2007 – 2008), the GERD was reduced in 2009 to 0.83% of GDP, or €383m, which is far from reaching the 3% goal.

Weak competitiveness, slow restructuring of the economy and low levels of export-oriented FDI, exacerbated with the effects of global financial and economic crisis have further downgraded R&D activities in most of the companies. Current growth trends of the economy characterized by adverse investment climate, insufficient enterprise development, low levels of innovation and low competitiveness are not promising, which significantly slows down the development of knowledge demand, as well as knowledge production.

However, some policy changes can be identified in the area of knowledge demand drivers. The framework of regional development has been defined within the Law on Regional development (OG 153/09) and Strategy on Regional Development has been introduced in 2010, which should facilitate competitiveness-enhancing activities (including R&D), but the framework for funding of regional projects has not been redefined yet.

Research efforts to address major societal challenges

The global challenges related to the fresh and sea waters, soil, agriculture, air and climate change are addressed in Croatia by Croatian Environment Agency. The ageing of the society is a topic of many projects related to demographic studies and reforms of pension system. The new Energy Strategy of Croatia adopted in June 2009 fully recognised the EU climate and energy targets by 2020, known as the "20-20-20" targets.

Generally, there is lack of specialised research programmes aimed at major national and global societal changes. However, as stated in Chapter 2.5.3., within the SEE-ERA.NET PLUS programme the two societal challenges - ICT and food - are selected to be financed by the Joint call for European research projects in the period 2009-2013.

2.4 Knowledge production

The production of scientific and technological knowledge is the core function that a research system must fulfil. While different aspects may be included in the analysis of this function, the assessment provided in this section focuses on the following dimensions: quality of the knowledge production, the exploitability of the knowledge creation and policy measures aiming to improve the knowledge creation.

2.4.1 Quality and excellence of knowledge production

The investment in R&D in Croatia is rather modest and amounts to €85.8 per capita which is only 18% of EU average (€473.4 per capita). The largest gap is in the business sector which invests €34.7 per capita or about 12% of EU average. That is definitely insufficient for the world-class research especially in science and technology, as well as for productive use of knowledge.

The research infrastructure is primarily national in character. The public research (technological) organization and the higher education institutions have a large autonomy within the Universities in Croatia, with significant fragmentation of resources including present research infrastructure and equipment. As a result of this process, small research units with research infrastructure tools dominate. In order to avoid duplication and enable networking and integration, the MSES has established the [Register of the capital equipment](#) (above €30,000).

In addition, the accesses to the large international research infrastructures like CERN, EMBL (European Molecular Biology Laboratory, EUMSTAT (EU meteorological satellites) through the membership and research collaboration is of great importance for achieving scientific excellence.

The majority of human resources is concentrated at the University of Zagreb (around half of all researchers and university teachers), at the Rudjer Boskovic Institute (IRB) in natural sciences (around 500 scientists), at the Brodarski Institute in technical sciences (around 50) and at the Institute Ivo Pilar in social sciences (around 100

scientists). University of Zagreb is the only university from Croatia included in the international rankings of universities – the Leiden Ranking (244 in the Green and 220 in the Orange ranking).

Initiation of the BioCentre (a bioscience incubator) within the IPA - Regional Competitiveness Operational Programme represents a new type of funds for building research infrastructure. Besides, the EU FP has recently appeared as an important resource for procurement of scientific equipment (e.g. particle detector system at IRB of around €1.5m). Financing of research infrastructures in order to implement ESFRI (European Strategy Forum on Research Infrastructures) road map is not planned yet in Croatia.

Some studies (Podobnik and Biljaković, 2008) have revealed that the overall productivity of Croatian scientists was beyond the average productivity in the world. Also, it has been shown that the productivity of Croatian scientists in “soft” sciences (listed in SSCI) was well below the productivity of their colleagues working in “hard” sciences (listed in SCI-Expanded). However, in the period from 2000 to 2005 the University of Zagreb published more papers in social sciences than other universities in the region including the University of Ljubljana (Slovenia).

According to the [SCImago](#) Journal and Country Ranking of 234 countries, Croatia was ranked at 48th place by the H-index² and at 195 place by citations per document. The exploitation of scientific results in the economy is rather low as well as the cooperation of science and industry. The main reason is in the low absorption capacities of the business sector and the dominance of the low-tech sectors in the structure of economy.

The patent applications are noticeably low compared to the EU-27 average. For the year 2005, Croatia has registered a small number of patent applications to the European Patent Office (EPO), only 6.65 per million inhabitants, while the average for EU-27 is 105.95.

2.4.2 Policy aiming at improving the quality and excellence of knowledge production

There are three main types of research evaluation aiming at improving the quality and excellence of knowledge: evaluation of individual researchers, evaluation of research projects and evaluation of HE/RTO institutions.

Evaluation of **the individual researchers** is carried out for the promotion of researchers into the higher scientific/teacher grade. The criteria are mainly based on bibliometrics indicators – the number of scientific papers in the relevant, highly-ranked international journals and the number of citations of papers which are listed in the [Croatian Scientific Bibliography](#) (CROSBI).

The evaluation of research projects includes ex-ante, interim and ex-post evaluation. Ex-ante evaluation usually includes international peer review process while interim and ex-post evaluations are mainly reduced to the number of publications and (Current Content) articles.

The most underdeveloped part of evaluation is performance assessment of the research and innovation programmes such as Zprojects, TEST, RAZUM, etc.

² H-index quantifies both the scientific productivity and the scientific impact of a journals

Although all projects within the programmes are subjected to serious ex-ante evaluation and monitoring, the ex-post evaluation at the aggregate level of programmes based on output indicators, international benchmarking or impact studies are regularly missing.

The evaluation of **individual research institutions and universities** is a novelty in science policy and was launched in 2007. It consists of the external evaluation usually carried out by the ASHE and internal (self) evaluation. Evaluation is, in principle, made by domestic experts but in case of large scientific institutions like the Rudjer Boskovic Institute, the Brodarski Institute, the University of Zagreb (see chapter 3.3.1) the foreign experts were also involved. However, the results of evaluation are not yet used as a base for institutional funding. Instead, the present criteria for institutional funding are rather formal and are based on a mere number of researchers and their scientific coefficients.

In order to improve scientific excellence at the institutional level, the Law on quality assurance in science and higher education system has been enacted in April 2009 (OG 45/2009). It regulates the procedures of periodic external independent assessment of the internal quality assurance system (audit), initial accreditation and re-accreditation procedures and thematic evaluations of study programmes. The Law also regulates the status, activities and organization of the ASHE as the pillar institution of the national system of quality assurance of research in Croatia.

In order to foster scientific excellence via participation of Croatian researchers in EU FP, MSES introduced a new measure for Croatian partners who contract projects with a value exceeding €100,000. They are entitled to receive additional funds ranging from €5,500 to 14,000 from the national budget. However, this decision regarding co-financing was revoked by the Minister in March 2010, with retroactive implementation from 1 June 2009.

2.5 Knowledge circulation

Tackling the challenges that European society faces in the 21st century will require a multi-disciplinary approach and coordinated efforts. Many debates and conferences, e.g. the Lund Declaration recognise that such complex issues cannot be solved by single institutions, technology sectors or MS acting alone. Hence strong interactions within the "knowledge triangle" (education, research and innovation) should be promoted at all levels. Moreover, in the context of increasing globalisation, cross-border flows of knowledge are becoming increasingly important. This section provides an assessment of the actions at national level aiming to allow an efficient flow of knowledge between different R&D actors and across borders.

2.5.1 Knowledge circulation between the universities, PROs and business sectors

The activities essential for the development of a knowledge transfer and commercialisation which are critical for building the knowledge-based economy are carried out under the responsibility of the Business Innovation Centre of Croatia (BICRO) and the Croatian Institute of Technology (HIT).

The policy measures related to innovation which have an impact on research activities include TEHCRO (a technology infrastructure managed by BICRO), RAZUM (development of technology-based firms), establishment of biotechnology infrastructure with an incubator and a central laboratory (BIOCentre) and the

launching of the Science and Innovation Investment Fund, which is financing technology transfer and associated activities. The last two measures are being financed within the IPA programme.

In addition to the TEHCRO programme, the most important step forward in supporting entrepreneurship activities and establishing of the technology transfer offices (TTO) at universities is made in the framework of the three TEMPUS projects: CREATE, OPUS and FoSEntHE. The FoSEntHE project is aimed at fostering entrepreneurship education at universities while CREATE and OPUS has supported launching the three technology transfer offices at the universities of Split, Zagreb and Rijeka. The latter has grown into the Science and Technology Park (STeP) attached to the University of Rijeka.

Scientific community is oriented primarily towards scientific outputs due to the present methods of evaluation of scientific work which stimulate standard scientific work (publications). Important reasons are hidden in socio-cultural and political factors. A special problem is that science-industry cooperation and technological outputs which are not recognised as factors of scientific promotion. Therefore, in spite of many efforts to promote public - private partnership some recent analyses (Radas and Vehovec, 2006; Švarc at al, 2011) reveal that the interaction between universities and industry in Croatia is still rather limited and need to be explicitly looked for and enforced.

2.5.2 Cross-border knowledge circulation

Cross-border cooperation plays a significant role in the development of Croatian regions since most of Croatian territory is on the borders (18 of 21 counties). The main instrument is the Component 2 of the IPA focused on the cross – border cooperation between Croatia and EU countries (Slovenia, Hungary Italy) and non EU countries (Serbia, Montenegro B&H) as well as IPA ADRIATIC CBC. With the exception of the Priority 1 of the [IPA ADRIATIC CBC](#) that includes Measure 1.1. Research and innovation, other programmes are mostly aimed at the development of economic and social cross-border activities, solving common infrastructural or communal problems, cultural cooperation, tourism, etc. However, it can also include knowledge circulation within single projects such as cross-border university cooperation (e.g. Croatia – Hungary).

The [SEE-ERA.NET PLUS](#) programme (see 3.5.3) could be considered as a sort of cross border cooperation since it is aimed at enhancing the integration of the Western Balkan countries by a Joint call for European research projects.

2.5.3 Main societal challenges

Within the [SEE-ERA.NET PLUS](#) programme the two societal challenges - ICT and food - are selected to be financed by the Joint call for European research projects in the period 2009-2013. The call budget is €3.5m.

2.6 Overall assessment

Table 3: Summary of main policy related opportunities and risks

Domain	Main policy opportunities	Main policy-related risks
Resource mobilisation	<ul style="list-style-type: none"> • Further opening up to the ERA should increase available resources and improve R&D efficiency 	<ul style="list-style-type: none"> • The unfavourable structure of the economy, exacerbated by the economic crisis, diverts resources from R&D
Knowledge demand	<ul style="list-style-type: none"> • Increasing the effectiveness of industrial, regional, SME and FDI policies in order to stimulate knowledge demand 	<ul style="list-style-type: none"> • The science-industry cooperation is weak
Knowledge production	<ul style="list-style-type: none"> • Opening up to ERA and increased investments into research infrastructure should lead to improved knowledge production • More effective evaluation of research projects and results 	<ul style="list-style-type: none"> • Significant improvements in knowledge production require reforms that may face significant obstacles
Knowledge circulation	<ul style="list-style-type: none"> • Successful Croatian FP participation would provide opportunities for knowledge circulation • Development of technology transfer, academic entrepreneurship and attraction of knowledge-intensive FDI 	<ul style="list-style-type: none"> • Improvements in knowledge circulation require complex adjustments in academic, private and public sectors

Table 4: Main barriers to R&D investments and respective policy opportunities and risks

Barriers to R&D investment	Opportunities and Risks generated by the policy mix
The structure of the national economy is dominated by the low-tech sectors while innovation capabilities of SMEs are weak.	The present policy mix is focused on R&D in companies and science-industry cooperation without visible impact on economy; it should be directed towards fostering innovative clusters and building the technological capabilities of companies.
There is a huge lack of research workforce in the private sector (only 22% of the EU average (0.14% in Croatia versus 0.62% in the EU-27);	The present policy mix does not address the number of researchers in the business sector directly; the additional measures for strengthening R&D in companies already dealing with R&D should be put in place to stimulate them to hire researchers.
There is a lack of structural reforms of technology obsolete sectors (e.g. shipyards, agriculture) that absorb huge state subsidies which could be otherwise used for innovation.	The subsidies should be redirected towards large-scale technology programmes which should involve all the innovation stakeholders at the regional or national level.
Foreign-direct investments and international trade is focused on non-technological products.	The present policy mix does not involve any serious FDI strategy, especially not for innovation based FDI; therefore the new set of policy measures to attract FDI in the knowledge intensive sectors and sectors of higher added-value should be implemented.

3 Interactions between national policies and the European Research Area

3.1 *Towards a European labour market for researchers*

The [Communication Better careers and more mobility: A European Partnership for Researchers](#) proposed by EC in May 2008 aims to accelerate progress in four key areas:

- Open recruitment and portability of grants;
- Meeting the social security and supplementary pension needs of mobile researchers;
- Providing attractive employment and working conditions;
- Enhancing the training, skills and experience of researchers.

The Commission has also launched concrete initiatives, such as dedicated information services for researchers, in particular through the activities grouped under the name of [EURAXESS – Researchers in Motion](#). Based on the assessment of the national situation in the four key dimensions detailed above, this section will conclude if national policy efforts are supporting a balanced ‘brain circulation’, with outward mobility levels matching inward mobility levels. High levels of outward mobility coupled with low levels of inward mobility often signal an unattractive national labour market for researchers and unsuitable research infrastructures. This may trigger, despite the policy efforts supporting the mobility the ‘brain drain’ rather than brain circulation.

3.1.1 **Stocks and mobility flows of researchers**

The outward and inward mobility have increased in Croatia since 2000 mainly due to the institutional reforms and policy measures driven by the possible accession of Croatia to the EU. However, the mobility of teaching staff and students is not very strong. Croatia currently has a very low percentage of inflow of students since only 0.1% of all students are incoming students (Eurostat, 2007) while 6.2% of all Croatian students study abroad. The share of the EU doctoral students in the total PhD students in Croatia was 0.3% in 2007.

The most important measures for mobility are taken within the Bologna process of harmonisation of the Croatian higher education sector with the EHEA and within full participation of Croatia in the ERA in the domain of scientific research. Croatian policy makers have followed the main recommendations and trends in these two framework EU initiatives which have resulted in:

- Launching the new mobility programmes, e.g. “Brain gain-Visitor”, “Fellowships for doctoral students”, “Unity through knowledge fund”, etc.;
- Opening scholarships schemes for the Croatian under-graduate and graduate (doctoral) students via Scholarship fair and internet portal organised by the Institute for the Development of Education (IDE);
- Establishing of ENIC/NARIC office (qualification recognition);
- Establishing the Agency for mobility and EU programmes (in October 2007);

- In 2008 Croatia launched the Action Plan to Encourage Absorptive Capacity of the Republic of Croatia for the FP7 in the period 2009-2010, whereby researchers' mobility is treated as an instrument to strengthen human capacity;
- Participation of Croatia in the EU mobility programmes such as Marie Curie-People, EURAXESS and Erasmus Mundus (the latter two are open from 2008/2009).

In 2008, the number of tertiary graduates (ISCED 5-6) in science and technology per 1000 persons aged 20-29 years was 10.1. This is still lower than EU-27 (13.9), but there has been a significant improvement since 2003, when the corresponding figure was 5.6.

The percentage of new doctorate graduates per 1000 population aged 25-34 was 0.8% in 2009 that is only 57% of EU average (1.4%). However, the trends are positive. In 2007, the number of new doctorate graduates per 1000 population aged 25-34 was 0.7%.

The share of doctors of science in the population is very low and amounts to 0.25% of population while the target is to increase their share to 1% of population in the next 10 years.

Total of 572 doctors of science graduated in 2009, with the average age of 38.1 years, while the modal group (with the highest frequency) consisted of persons aged 30 to 34. On the average, women were somewhat younger (37.5) than men (38.6).

The human resources in science and technology (HRST) as a share of labour force in Croatia were 31.6% in 2009 whereas in developed countries it often exceeds 50% (EU-27 - 39.8% in 2008). However, the trends are positive – in 2006, the corresponding indicator was at 29.2%.

The distribution of researchers by institutional sector in 2009 was as follows. When total number of researchers expressed in head counts (16072) is considered, 53.16% work in HEI, 26.44% in the government sector, 20.28% in the business sector and 0.18% in the non-profit sector. When FTE data are taken into account, it can be observed that 51.24% work in HEI, 29.48% in the government sector, 19.11% in the business sector and 0.16% in the non-profit sector. The total FTE number of researchers is 6,529.5.

Academic staff in country has a status equivalent of civil servants. Temporary contracts are subject to social and health contributions. The share of permanent positions in HEIs and PROs occupied by foreigners is not monitored, but figures are supposed to be very low. Most foreign-born are permanent residents and often also hold a Croatian citizenship. Their stay tends to be motivated by personal and family reasons.

Based on the questionnaire administered by the MSES in January 2010, higher education institutions in Croatia estimate that in the 2011/2012 academic year they will have a total of 1,036 outgoing mobility students (0.6% of total number of students). The expected number of hosted students in the same academic year is 360 foreign students, mostly within the framework of ERASMUS programme.³

³ The Action Plan for Overcoming Obstacles and Enhancing International Mobility in Education for the Period 2010 – 2012

The participation of foreign scientists in research projects has been significantly simplified with the adoption of the Regulations on the establishment of conditions for granting temporary residence for foreigners (OG 42/08) in 2008. Until October 2010 29 applications for hosting of foreign researchers has been approved. The institutions with greatest mobility of researchers are: Ruđer Bošković Institute (7), Faculty of Science, University of Zagreb (7), Mediterranean Institute for Life Sciences – MedILS (3), Institute of Croatian Language and Linguistics (3), Institute of Ethnology and Folklore Research (3), Croatian Forest Research Institute (2) and Medical Faculty, University of Rijeka (1).⁴

The new Action plan for mobility of researchers 2011 – 2012 was introduced in December 2010, with two main goals: (1) removing the obstacles for mobility of researchers and (2) increasing the international and inter-sectoral mobility. Measures within these two goals include: (1) Employment of foreign researchers on science and science-educational working places; (2) Enhancement of working conditions for researchers; (3) Regulation of residence for the purpose of scientific research; (4) Further development of infrastructure for mobility of researchers; (5) Encouraging inter-sectoral mobility of researchers, and (6) Strengthening the researchers' competences.

The Action Plan for Overcoming Obstacles and Enhancing International Mobility in Education for the Period 2010 – 2012 has also been introduced and adopted in September 2010 and is expected to further facilitate the mobility of researchers, as well as status of foreign researcher in Croatia.

3.1.2 Providing attractive employment and working conditions

According to the CBS data, the salaries of researchers both in private and public sector are above the national average. However, they are below the average of most EU countries⁵, which significantly reduces the demand for inflow of researchers in the country.

The faculties select and employ professors and other personnel and design their education programmes. However, the faculties cannot set the basic salary for their employees who receive income from the MSES directly; but the salary represents a part of the block grant, as financial incentives and also a source of revenue for the scientific institutions. The faculties can introduce additional stimulus in addition to the monthly salaries. Research Institutes are the responsibility of the MSES and are not university units. Similar to faculties, the institutes select and employ scientists and other personnel and design their scientific activities. The autonomy of the Universities enhances the autonomy of the internal organization i.e. the faculties. The faculties are responsible for the design of educational and scientific programmes, finances and applications for international projects. The autonomy is tightly connected with obligations of the university towards the students, ensuring the provision of quality education as well as obligation of accountability towards the public, society and the local community.

By the October 2010, all the universities and research institutes have signed and adopted the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers. The Charter and the Code of Conduct (March 2005),

⁴ Ibid

⁵ 2007 EC report „Remuneration of Researchers in the Public and Private Sectors“

document by the European Commission, ensure the same rights and obligations for all researchers in Europe. The Charter lays out the rights and obligations of researchers and R&D organizations. The Code of Conduct has the goal of ensuring both the equal treatment of all researchers in Europe and increased transparency in the recruitment and employment process.

3.1.3 Open recruitment and portability of grants

Several measures have been implemented within the Action plan for mobility of researchers 2009-2010, such as:

- the transparency of the recruitment of scientists in the Croatian scientific organizations has been increased through the publication of advertisements for jobs in research portal EUROAXESS. In October 2010 the 46 Croatian institutions were registered on the website which have announced total of 113 job advertisements;
- the rules for scientists registration have been changed in the way that Croatian citizenship is no longer a condition for entry into the Register of scientists, which raised the possibility of employment of foreigners on scientific jobs and as project managers;
- printed and web brochures with practical information for mobile researchers have been made, as well as detailed manuals intended for the administrative staff in the Croatian scientific institutions in which the administrative procedures related to residence and work of foreign researchers are described;
- consultations with the Croatian Health Insurance Institute were held, where it was decided not to start signing new contracts for health insurance as the membership of Croatia in the EU is soon expected and Croatia will adopt the European acquis;
- all Croatian scientific institutions have signed the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers;
- By the adoption of Regulations on the license contents and the conditions for issuing permits for carrying out scientific activities and scientific organizations re-accreditation (OG 83/10), collaboration with industry is recognized as one of the criteria in the evaluation of scientific institutions.

The immigration policies for attracting foreign researchers and for mobility of researchers have also been improved (see Chapter 3.1.1.).

In 2009, MSES established the Committee for Hosting of Foreign Researchers in Croatia to assist the process of hosting foreign researchers on research projects implemented at Croatian universities and institutes. Finally in September 2009 the MSES established the Committee for the mobility of researchers which has prepared the Action plan for the mobility of researchers.

3.1.4 Meeting the social security and supplementary pension needs of mobile researchers

The Scientific Visa package has been implemented in Croatia. Foreign researchers are exempted from the work permit or operating license requirement, provided that they do not reside in the Republic of Croatia for more than 90 days during a year. Temporary stay is granted to foreigners studying at a higher education

institution in the Republic of Croatia (postgraduate university study) and meeting the prescribed conditions: he or she has means of supporting him- or herself, a place to live, there are no obstacles for granting entry to the Republic of Croatia and he or she has justified the purpose of temporary stay. The temporary stay permit for the purpose of studies is valid up to one year, that is, until the end of the academic year.

In order to enhance the mobility of researchers, within the Action plan for mobility of the researchers 2011-2012 the following measures are to be implemented: (1) enabling the transfer of allocated funds and the transition of young researchers from one project to another, (2) the recognition of experience acquired abroad to returnee scientists and other mobile scientists, (3) improving access to information on legal provisions and procedures related to the hosting of foreign researchers, (4) encouraging further career development of researchers in an earlier stage of their career, (5) increasing the flexibility in administrative procedures for researchers who are at the end of their career (6) supporting the implementation of the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers and the Charter and the Code of Conduct. The implementation of these measures should ensure the effective meeting of the social security and supplementary pension needs of mobile researchers in Croatia.

3.1.5 Enhancing the training, skills and experience of European researchers

International cooperation of education institutions in Croatia is underdeveloped and mainly limited to a few prominent institutions and individuals. Engagement on international projects has not been recognised adequately, although in addition to regular workload it often requires substantial additional work. Moreover, at majority of education institutions, administrative capacities and competencies of institutions related to project activities and international cooperation are insufficient. This problem has been recognised by the MSES and several measures have been introduced in order to enhance the international cooperation of education institutions in Croatia. These measures are to be implemented by the end of 2012, with the expected result of increased administrative capacities and more active participation of education institutions in international mobility programmes.

Researchers in Croatia usually have access to traditional programmes which often lack the knowledge needed for business management, intellectual property management, project financing and starting a business. Researchers working in small and medium sized businesses often have to manage projects, communications or intellectual property. On the other hand, senior researchers are often losing a step with the development of new technologies and methods, as well as the lack of support for developing skills in the process of assuming a managerial position.

The Action plan for mobility of researchers states several measures that are to be implemented during 2011 and 2012 in order to enhance the training, skills and experience of researchers: (1) examining the current situation; (2) development of national programme of skills and competencies for researchers; (3) encouraging the introduction of additional education in entrepreneurship and intellectual property in universities and (4) encouraging the establishment of specialized studies.

Lack of courses held in foreign languages has been a barrier for potential incoming foreign students at higher education institutions in Croatia. The University of Zagreb has recognised this problem and in the academic year 2009/2010 had announced a call for elaborating current courses to be held in foreign languages. The University of

Zadar has taken over this model as an example of good practice. By the end of 2011, the MSES has obliged to ensure that study programmes would be developed and upgraded additionally in foreign languages through specially designed projects financed by EU funds (Component IV of the IPA: Operational Programme for Human Resources Development, and the European Social Fund).

3.2 Research infrastructures

Research infrastructures (RIs) are a key instrument in the creation of new knowledge and, by implication, innovation, in bringing together a wide diversity of stakeholders, helping to create a new research environment in which researchers have shared access to scientific facilities. Recently, most EU countries have begun to identify their future national RI needs, budgets and priorities in the so called National Roadmaps for Research Infrastructures. These strategic documents also set out a strategic view on how to guarantee and maintain access to research facilities. Although some countries invest heavily in RIs, none can provide all the required state-of-the-art facilities on a national basis. Several large RIs have already been created in Europe. While optimising the use and development of existing RIs remains important, new infrastructures are needed to respond to the latest research needs and challenges. European Strategic Forum for Research Infrastructures ([ESFRI](#)) was established in April 2002 to support a coherent approach to policy-making on RIs in Europe and to act as an incubator for international negotiations on concrete initiatives. This section assesses the research infrastructures national landscape, focusing on the national RI roadmap and national participation in ESFRI.

3.2.1 National Research Infrastructures roadmap

Croatia has experienced moderate development of the research infrastructure network. There is no precise infrastructure inventory so only broad estimates can be used. According to the CBS, there were 202 institutions in 2005 with infrastructure that could be described as research infrastructure (77 of them in technical sciences whereas 32 out of them in biomedicine as well as human science). In terms of the research infrastructure investments, exact data does not exist. But in 2005 the gross investment which includes research infrastructure investments represented 20.1% of total investments in the R&D sector (HRK466m, approximately €63m) (CBS). The largest proportion of the gross investments (33.6%) in total investments was observed in the business sector (HRK320m, approximately €43.3m). In the period 2000 - 2005 the increase of gross investments had been evident; however gross investments as a percentage of total investments remained stable around 20% in the last few years.

The research infrastructure is primarily national in character. The public research (technological) organization and the higher education institutions have a large autonomy within the Universities in Croatia, with significant fragmentation of resources including present research infrastructure. As a result of this process, small research units with research infrastructure tools dominate. The Rudjer Boskovic Institute (807 employees more than 500 scientists) and The Brodarski Institute (169 employees out of them 50 scientists) can be excluded as exceptions.

However, in the last few years a broader approach to research infrastructure has emerged primarily in the ICT sector a top down approach has been initialized by the government. «e-Hrvatska» the institution responsible for ICT infrastructure development in Croatia, implemented two programmes relating to research

infrastructure, in addition to Broadband Internet and HitroNet aimed at building centralized network of public services. Moreover, MSES have been constantly improving the CARNET network implementing the programme of distant learning. Moreover, MSES, jointly with CARNET and the Rudjer Bosković Institute launched the «Center for on-line data base» project ensuring a network approach to commercial databases and providing free databases for the science and research communities in Croatia (scientists, assistant and students).

The realization of the MEDILs project i.e. foundation of the life science institute in 2005 and initialization of Bio science incubator within the Regional Competitiveness Operational Programme as an Instrument for Pre-Accession Assistance Programme represent a bottom up approach in building research infrastructure and at the same time a result of a long tradition as well as scientific excellence in biomedicine. Moreover, financing the research infrastructure in order to implement ESFRI (European Strategy Forum on Research Infrastructures) road map is not planned as yet in Croatia.

An important source of research infrastructure is the REGPOT programme. For example, in 2009 the IRB was allocated €1.3m for particle detectors while the Medical School in Rijeka received €1.8m for the equipment.

Croatia has not applied a strategic approach and policy objectives and strategies in accessing intergovernmental European infrastructures. Access to the national research infrastructure within the scientific institutions is organized by the Agency for Mobility and European Programmes (see chapter 4.1.2). Regarding inclusion into Inter-governmental research organisations, as a result of multilateral agreements Croatia is a member of the European Molecular Biology Organization (EMBO), Conference and European Centre for Medium-Range Weather Forecasts as well as engaged in programme of the European Organisation for Nuclear Research. Moreover, Croatia has signed more than 200 bilateral agreements in the area of science and research in the last ten years. One of the key aspects within the bilateral agreement is research project cooperation in local science and research infrastructure.

3.2.2 National participation in the *ESFRI roadmap*. Updates 2009-2010

Research infrastructure financing in order to implement ESFRI (European Strategy Forum on Research Infrastructures) road map is not planned as yet in Croatia.

3.3 *Strengthening research institutions*

The ERA green paper highlights the importance of excellent research institutions engaged in effective public-private cooperation and partnerships, forming the core of research and innovation 'clusters', mostly specialised in interdisciplinary areas and attracting a critical mass of human and financial resources. The Universities/ research institutions should be embedded in the social and economic life where they are based, while competing and cooperating across Europe and beyond. This section gives an overview of the main features of the national higher education system, assessing its research performance, the level of academic autonomy achieved so far, dominant governing and funding models.

3.3.1 Quality of National Higher Education System

Tertiary education institutions in Croatia include universities, polytechnics and schools of professional higher education. Universities may include faculties and academies of arts as legal entities and may establish a number of other constituent units (departments, institutes, etc.). In Croatia there are around 58 faculties and 31 university departments gathered around seven university centres (Zagreb, Rijeka, Osijek, Split, Zadar, Dubrovnik, Pula) (see the [Portal](#)).

Besides the universities that are all public, there are 13 public and 3 private polytechnics and 3 public and 25 private schools of professional higher education. In contrast to public polytechnics which are mainly oriented towards technical professions, private schools of professional higher education and polytechnics are mainly established in the more lucrative areas such as economics, management and business.

The main purpose of the HEIs is teaching and research. The third mission of universities is rather new practice introduced by the EU technical assistance projects (CARDS), followed by the three TEMPUS projects: [CREATE](#), [OPUS](#) and [FoSEntHE](#).

The turning point in the development of all the universities in Croatia occurred in July of 2003 when the Law on Scientific Activity and Higher Education was adopted. It offered the framework for the implementation of the Bologna process, introducing the legal and functional integration of universities, a lump-sum as the basis for financial management, system of ECTS, quality assurance system, etc. Unfortunately the internal organisation of the Croatian university has remained traditional one functioning as a loose association of its constituents. The faculties are still legal entities (that is completely incompatible with the western-type of university organisation) and have pronounced independence from the universities that make a gap to functional and legal integration recommended by the Bologna process and needed for faster strategic development. In order to reform the higher education and research system the Government proposed a triplet of the Law on Science, the Law on Universities and the Law on Higher Education in October 2010. The proposed changes are huge and severely criticised. Some good intentions such as functional integration of universities (that in practice means the dismantling of large universities such as the Zagreb on several smaller universities) are overcome by many incomplete and questionable solutions, such as strong political control over the university and science management, implementation of the so-called pyramidal systems of scientific jobs (meaning in practice impossibility for scientists and young scientists to progress in their career), market orientation of doctoral graduates (they lose their job positions after graduation), revitalisation of master studies, strong market orientation in financing since the state provides maximum of 60-80% of the budget for research institutions without taking the responsibility of the salaries and intuitional funding (overheads), etc. The latter would lead to a breakdown of some university departments and even entire public institutes.

Croatia has 143,000 students or 32.5 students per thousands inhabitants that is 85% of the average of EU-27, which has 38% of students per thousands inhabitants. The share of female students was 58.6%, which was a stable number compared to the previous year.

As reported by the CBS the higher education sector made up 32% of GERD in 2009 (government made 27% and business sector 40%) and participates with 0.27% of R&D expenditures in GDP (HERD).

As reported by Eurostat for 2008, the majority of university students graduated in social sciences, business, law, and training (almost 54.7% of all graduates), in technical sciences, mathematics and computing, (22.9%), agriculture and veterinary (3.4%), health and welfare (8%) and services (11%).

The only university from Croatia listed on international ranking list is the largest university in Croatia - University of Zagreb that is listed in the Leiden Green (244) and Orange rankings (220).

The system of quality assurance has been started in 2005 and nowadays it comprises: (1) the accreditation of academic programmes, (2) the accreditation of HEIs and (3) the audit of quality assurance systems. The audit of quality assurance systems (evaluation) of HEI consists of an external evaluation carried out by the ASHE and international evaluators and internal evaluation carried out by institutions themselves according to the guidelines provided by AZVO.

However, the results of evaluation are yet not used as a base for institutional funding (such as the government's Research Assessment Exercise for UK). Instead, the present criteria for institutional funding are rather formal and include input from a number of researchers and their scientific coefficients. Out of seven Croatian universities three have already established quality assurance offices (Zagreb, Rijeka, Split).

In order to improve scientific excellence at the institutional level, the Law on quality assurance in science and higher education system has been enacted in April 2009 (OG 45/2009). It regulates the procedures of periodic external independent assessment of the internal quality assurance system (audit), and organization of the ASHE as the pillar institution of the national system of quality assurance of research system in Croatia.

3.3.2 Academic autonomy

The Croatian universities have a high degree of **academic and political autonomy** to decide about their internal issues and strategy. The universities share **similar governance structure** that consists of the Rector, the Senate, the University Council and sometimes the Rector's Collegium. The decision –making process can be characterised as the "Senate model" since the Senate is the highest decision-making body while the University council has a supervisory and counselling function to the Senate and Rector. The Rector is elected through the tender process among peers, e.g. from the university teachers with title of full professor.

The Senate consists mainly of teaching staff (60%) and representatives of students and other employees while representatives from wider society and economy are usually not included. However, the university council incorporates representatives from the local-government bodies (e.g. cities) and the Croatian Chamber of Commerce (about a quarter of members).

Universities are completely autonomous in recruiting researchers for certain positions. However, they do not have any influence on their salaries since the degree of universities' **financial autonomy** is rather low. Majority of funds (85%) allocated by the central state are aimed at the salaries for researchers which are pre-determined by the central state (in negotiation with the Union of scientists and pre-defined by the Collective agreement). Remaining resources are allocated to the universities as the lump-sum but a significant part of these funds have been also

agreed between the government and the faculties before allocation, providing a small room for university for independent financial management.

3.3.3 Academic funding

As reported in 2009, the government finances about 80% of research at universities, while the business sector finances about 10% of university research. The remaining resources come from abroad, private, non-profit and own resources. Budget funds are provided by the MSES through institutional funding, research projects grants and other smaller supporting programmes. Budget funds make around 70% of total revenues of the universities while remaining are coming from scholarships and commercial projects. The criteria for institutional funding (block grant) are not linked to scientific results. Instead, they are rather formal and include input from a number of employees and number of students. Research grants are awarded through the competition-based programme Research Projects directly to research teams. In the last 5-year project cycle, universities performed 70% of all research projects and spent 66% of all research grants. Universities can make decisions for allocating resources autonomously. However, as pointed above, universities are only a loose association of its constituents – faculties – that are still legal entities and are entitled to make financial decisions.

3.4 Knowledge transfer

The importance of knowledge dissemination and exploitation in boosting competitiveness and contributing to the effectiveness of public research has been increasingly recognised by EC and EU Member States. Following the publication of the [ERA Green Paper](#) in April 2007, the EC Communication "[Improving knowledge transfer between research institutions and industry across Europe](#)" was issued, highlighting the importance of the effective knowledge transfer between those who do research, particularly HEIs and PROs, and those who transform it into products and services, namely the industry/SMEs.

Several Member States have taken initiatives to promote and facilitate knowledge transfer (for instance new laws, IPR regimes, guidelines or model contracts) and many others are planning to intensify their efforts in this direction. However, these initiatives are often designed with a national perspective, and fail to address the trans-national dimension of knowledge transfer. This section will assess the national policy efforts aimed to promote the national and trans-national public-private knowledge transfer.

3.4.1 Intellectual Property Policies

Policy measures related to the intellectual property protection and patents are reasonably developed in Croatia. These activities are regulated by the Act on Patents and related Acts and fall under the responsibility of the Croatian State Intellectual Property Office (CSIPO). There are no special legal regulations covering the field of intellectual property rights (IPR) on Croatian universities. IPR at universities is stipulated by the Labour Act which refers primarily to the inventions and relations between inventors (employee) and employers and gives the rights of appropriation to the employers. This basic principle extends in practice to other areas including research and HE institutions by providing those institutions with free disposition of the IPR. The research community in Croatia has, therefore, a wide range of options to arrange IPR. However, there are still modest capabilities regarding IPR which

requires a systematic approach to develop the strategy and policy on this matter. First steps have been taken within the CARDS 2003 project for establishing the IPR infrastructure and strategy entitled Intellectual Property Infrastructure for the R&D Sector, as stated in Chapter 3.4.2. - *Promoting research institutions - SME interactions*.

3.4.2 Other policy measures aiming to promote public-private knowledge transfer

Involvement of private sectors in the governance bodies of HEIs and PROs

The cooperation between science and industry in Croatia is of growing significance. However, the science-industry cooperation, as well as involvement of private sectors in the governance bodies of HEIs and PROs is rather weak and investments in R&D are largely dominated by Public Sector.

Inter-sectoral mobility

The special mobility schemes allowing R&D students/PhDs/ to conduct innovation projects in firms are not widely present. There is only one programme run by UKF Research in industry and academia grant that addresses directly the inter-sectoral mobility, while others are aimed at science-industry cooperation. However, the new Action plan for the mobility of researchers 2011 – 2012 has put a great emphasis on the inter-sectoral mobility of researchers. The measures that are to be implemented by the end of 2012 include: (1) Facilitating the access to research results and encouraging the expansion of their usage; (2) Facilitating access to financial sources; (3) Investments into the mentor capacities for young researchers and (4) supporting the implementation of existing and future EU initiatives targeted toward eliminating barriers to inter-sectoral mobility. Also, in 2011 Croatia is going to gain full access to Lifelong Learning Programme, which encourages the cooperation among European education institutions and mobility of researchers in education.

Promoting research institutions - SME interactions

Based on CARDS 2003 project - Intellectual Property Infrastructure for the R&D Sector and several TEMPUS programmes, offices for technology transfer (TTO), attached to universities and the Rudjer Boskovic Institute have been established across Croatia. In addition, there are measures of the TEHCRO programme of BICRO (Technology infrastructure development), under which the development of the six technology centres or parks is currently supported. Together, these institutions represent the basic infrastructure for university-industry cooperation and for more intensive involvement of universities in research commercialisation and cooperation with the local economy.

The Ministry of Economy, Labour and Entrepreneurship (MELE) also has substantial role in the innovation system related to entrepreneurship and business infrastructure development, such as supporting entrepreneurial zones, incubation centres, business centres and regional development agencies. The entrepreneurial infrastructure supported by MELE is comprised of 27 business centres, 16 business incubators and six regional development agencies. In addition, there are 15 economic free zones and 235 entrepreneurial zones, out of which 140 are fully functioning. Fourteen incubators out of the 16 established are in the early stages of development.

In addition, with the aim of strengthening the connections between public and private sectors as part of a project funded by the World Bank (the Croatian Science and

Technology Project), the Agency for technology transfer - Rudjer Inovacije d.o.o., under the ownership of the Rudjer Boškovic Institute, was established.

EU cohesion policy

Croatia is still not an EU member so it is not directly affected by the EU cohesion policy. However, as a candidate country, Croatia has been receiving EU financial aid under the Instrument for Pre-accession Assistance (IPA) since 2007, which also needs to develop the capacity for future absorption of structural and cohesion funds. Within the Regional Competitiveness Operational Programme (IPA IIIc), two very significant operations are being implemented and are expected to have great impact on enhancing technology transfer and support services for knowledge-based start-ups in Croatia.

Science and Innovation Investment Fund (SIIF) is being implemented by the Ministry of Science, Education and Sports. The SIIF grant-scheme, which covers a comprehensive set of technology transfer activities, was launched in 2009 with an overall budget of €5m. In terms of beneficiaries, the call for proposals is limited to higher educational institutions (HEI) and public research organisations (PRO). The accompanying technical assistance supports project pipeline building through trainings and advisory services for project applicants, providing on-going help for grantees during the implementation period of the projects.

The Biosciences technology commercialisation and incubation centre (BIOCentre) will provide necessary facilities, equipment and services for the development of biotechnology start-ups and SMEs. The project has recently (February 2011) been approved by the European Commission.

Spin-offs

Research or university spin-off companies are still rather rare in Croatia. This has much to do with the underdevelopment of the technology transfer processes, IPR awareness level and lack of systematic approach in development of strategies and policies in this area. In recent years, Technology Transfer Offices (TTO), attached to universities and the Rudjer Boskovic Institute, have been established across Croatia, but they still need a lot of work in facilitation of the entrepreneurship culture at academic institutions. A particularly interesting is the case of Rudjer Innovations, which has been set up as a company for innovation services and transfer of technology at the Rudjer Boskovic Institute, but which also provides active support to academic entrepreneurship, as well as to research-intensive companies that seek professional assistance. It has launched the three spin-off companies.

Furthermore, the Science and Innovation Investment Fund (SIIF), which is carried out within the IPA IIIc Regional competitiveness programme, is used for projects aiming to facilitate technology transfer, academic entrepreneurship and engage RTO and universities in the local and regional development. Seed funding for spin-offs can be obtained through the RAZUM programme, but this programme is primarily used by private companies. On the other hand, there are still no policy measures that attract venture capital and business angels to university spin-offs.

3.5 Cooperation, coordination and opening up national research programmes within ERA

The articulation between the R&D Framework Programmes, the Structural Funds and the Competitiveness and Innovation Programme is still underdeveloped in terms of

coordination, synergies, efficiency and simplification. Since Croatia is still not a full member of the European Union, there are some differences between Croatian and EU policies, which can hinder the development of critical masses of research excellence, as well as lead to the duplication of efforts, sub-optimal impacts of the different instruments and unnecessary administrative overheads. Differences between research selection procedures and criteria can also be an obstacle to the overall spread of excellence. This section assesses the effectiveness of national policy efforts aiming to improve the coordination of policies and policy instruments across the EU, all part of the drive to create an integrated ERA.

3.5.1 National participation in intergovernmental organisations and schemes

Croatia acquired a full membership in the EU FP in June 2006 (during FP6). In the period between 2002 and 2006, Croatia participated in the programme under the status of a third country, and therefore had only limited access to funding. However, all the countries of the "West Balkan" (except Kosovo/UNMIK) were assigned a status of associated countries to FP by the "FP7 Third Country Agreements" issued by the EC in 2009.

Croatia participated in that period with 154 partners and signed 134 project contracts based on which Croatian partners' activities were funded in the amount of €16.2m. The major part of the approved funds went for the INCO sub-programme (€3.6m) and for the priority themes Life Science, Genetics and Bio-technology for health (€2.3m), Sustainable Development, Global Change and Ecosystem (€2.3m) and Information Society Technologies (€2m). For full participation in the FP6, €6.4m was paid out, out of which €3.18m were provided from the state budget and the rest obtained from funds from the Croatian Phare programme.

Within the **FP7**, a total of 137 Croatian partners have contracted 108 projects with the EC co-financing in the amount of €23.9m. Total of 52.6% of funds went for the projects within "Cooperation" (€12.6m, out of which €4.2m for Transport), while 45.41% was spent for Capacities (€10.9m out of which €7.4m for Research potentials), and €0.47 m was spent Marie Curie actions.

Croatia has been a full member of **COST** since 1992. It has taken part in over 250 projects, and it is currently cooperating in 70 COST actions. The annual membership fee is around €7,000. Special attention should be paid to project COST B-35: Lipid Peroxidant Associated Disorders, whose coordination on the European level was entrusted to Croatia's largest institute for natural sciences, the Rudjer Boskovic Institute. Within the COST project, several significant international conferences were organised in Croatia in 2007, including Smart Health Care, which gathered experts from the fields of medicine, environment protection, social sciences and the humanities.

Croatia has participated in **EUREKA** programme since 2000. Up to 2010, Croatian organisations have participated in 31 completed projects with total value of €137.10m. Total of 57 Croatian organisations have participated in these projects, among which 17 are SMEs, 9 research organisations, 26 universities and 2 are National Administrations.

Croatian organisations are currently (November 2010) participating in 22 running projects (9 multilateral and 13 bilateral), out which 18 projects are implemented in cooperation with Slovenia. Total of 38 Croatian organisations are participating in

these projects (17 SMEs, 4 companies, 4 research organisations, 10 universities and 3 national administrations).

Croatia has officially joined the **European Molecular Biology Laboratory** (EMBL) in June 2006 as the organisation's 19th Member State. It is expected that the participation in such a world class European research organisation will give the rapidly growing field of molecular biology in Croatia a boost and will help integrating Croatia's scientific elite in the ERA. It should also provide the infrastructure and services needed to conduct research on the highest level as well as inclusion of Croatia in the renowned PhD Programme and advanced training for scientists in molecular biology.

The National Science Foundation (NZZ) carries out in cooperation with the **European Molecular Biology Organisation** (EMBO) a programme [EMBO installation grant](#) aimed at helping leading scientists in life sciences to set up research laboratory in Croatia.

Croatia has signed a cooperation agreement with **CERN** in 1991. Since 1998 Croatian physicists were mainly involved in the SPS heavy-ion programme, in the NA49 experiment, and in the preparation of the physics programme for [ALICE](#). Croatian authorities and scientific institutions renewed relations with CERN in 1998. Presently Croatia participates in the following projects: ALICE / CMS, CMS, LHC, OPERA and CAST.

The participation of Croatian scientists in CERN is defined by a separate memorandum. Co-financing of participation is made on functional basis, meaning that the MSES's financial contribution is provided only for the special experiments. It is considered very favourable because it pays only actual work, rather than formal membership. MSES has allocated in financial year 2003 around €70,000. The funds are intended for the travel costs of scientists from Croatia and minor equipment. The main collaborative institutions from Croatia are the Rudjer Boskovic Institute (IRB) which plays a role of the coordination in Croatia and the Technical University of Split. Company "KONČAR" (electrical equipment) makes parts for CERN projects.

3.5.2 Bi- and multilateral agreements with other ERA countries

Croatia has signed more than 200 bilateral agreements with the countries all over the world in the area of science and research in the last ten years. The majority of bilateral agreements are established via the MSES (see the [Bilateral cooperation](#) of the MSES) but this practice is now gradually being abandoned in favour of the direct inter-institutional cooperation (e.g. with the USA). One of the key aspects within the bilateral agreement is research project cooperation in local science and research infrastructure. The most important partner is Slovenia followed by Austria, Germany and Hungary. In the period 2001 – 2005 Croatia has 119 projects with Slovenia mainly in natural sciences (98) while the remaining were in agriculture (8), humanities (7) and medical sciences (6).

Croatia's educational, scientific, research, and sport institutions and non-governmental organizations participate in the global, European and regional organizations' multilateral programmes, which includes initiatives such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Council of Europe, the OESCE, the Central European Initiative, the Adriatic and Ionian Initiative, the Alps-Adriatic Working Group, Quadrilaterale, Stability Pact, the OECD (Organisation for Economic Co-operation and Development), NATO (North Atlantic

Treaty Organisation). Multilateral activities also take place with CEPUS (Central European Exchange Programme for University Studies), CERN (European Organization for Nuclear Research, Geneva), ESF (European Science Foundation), EMBO (European Molecular Biology Organization), IIR (International Institut for Refrigeration), ICGEB (International Center for Genetic Engineering and Biotechnology).

3.5.3 Other instruments of cooperation and coordination between national R&D programmes

Croatia participates with the several projects in the ERA-NET initiative such as HERA, HERA-JRP, ERACOBUILD, SmartGrids, etc. However, it is most active in the Southeast European Era-Net (SEE-ERA.NET) and its successor the SEE-ERA.NET PLUS project which started in April 2009 and will end in January 2013. This is a networking project aimed at integrating EU Member States and Southeast European countries in the European Research Area by linking research activities within existing national, bilateral and regional RTD programmes. The SEE-ERA.NET PLUS consortium consists of seventeen partners from fourteen countries (EU Member States, the South Eastern European (SEE) region and Turkey. Most prominently, [SEE-ERA.NET PLUS](#) launched a Joint call for European Research projects in September 2009 in order to enhance the integration of the Western Balkan Countries into the European Research Area. The call budget is €3.5m.

Croatia participates also in the FP7 (Capacities) [WBC.INCO-NET](#) project, a regional consortium project with the aim coordinate research polices in the Western Balkan Countries (WBCs) and set up a common agenda for research priorities in the six areas (energy, agro&food, ICT, transport, environment and health) and an action plan for innovation development.

Participation of Croatia in the initiatives undertaken under Art. 185 of the Treaty of Lisbon is not reported. There is also no data on participation of Croatian institutions in European Technology Platforms or Joint Technology Initiatives.

Participation in activities undertaken through frameworks supported by the European Science Foundation (ESF) is carried by the National Science Foundation (NZZ). The NZZ implements two ESF programmes: [ESF research networking programme and the EUROCORES programme](#).

The special policy approaches supporting the cooperation and coordination between national R&D programmes are not developed. The MSES provides the substantive parts of financial support for the scientific projects and activities that requires only coordination at the level of the Ministry carried out by the National Scientific Council (NCS). However, there are many other research and innovation programmes managed by BICRO, UKF, NZZ, HIT and SIIF that need coordination. It is estimated⁶ that Croatia has a bundle of mainly horizontal supporting programmes that sometimes creates rivalry among the public institutions and programmes and leads to a lack of synergy and efficiency of the public policies.

⁶ Bečić, E., Švarc, J. (2010), Smart specialisation: some considerations of the Croatian practice, *Int. J. Transitions and Innovation Systems*, Vol. 1, No. 1, 2010

3.5.4 Opening up of national R&D programmes

The essential programme for funding scientific projects in Croatia administered by the MSES (Zprojects) is not open to foreign researchers in terms of financing foreign researchers although establishing of the international research cooperation is one of the criteria of project's eligibility and success.

However, there are a number of other programmes aimed at attracting foreign researchers to work in Croatia. The most important is the "Brain gain" programme managed by the National Science Foundation (NZZ) that consists of the five sub-programmes: Postdoc, Visitor, Senior, Homing programme and the NZZ Installation Grant. NZZ also carries out the EMBO Installation Grant in cooperation with EMBO to help Croatian and foreign life scientists to establish research labs in Croatia.

The programmes are open to all foreign researchers being the main criterion for funding is scientific excellence.

A special [Unity Through Knowledge Fund](#) (UKF) supported by the World Bank Loan is established in order to support mobility and cooperation between Croatian scientists and Croatian research Diaspora. The final aim is to return Croatian scientists and professionals working abroad to Croatia. It consists of a number of specially designed programmes and instruments such as financing collaborative research projects, intensifying of researchers' mobility, young researchers' advancement, research commercialisation programme, etc.

From the perspective of the funding agencies like the NZZ and the UKF, there are no significant barriers for opening national programmes. However, these funds are not a major source of funding R&D in Croatia, but the Ministry of Science, Education and Sports. The main problem for opening MSES programmes is perceived in the lack of money in the national research funding system. The other major barriers are driven by the national legislation that requires employment of a principal researcher and a majority of research team in a national research organization. Although the immigration and mobility policies for foreign researchers have been improved (e.g. the Ordinance on the method of determining requirements for approval of temporary residence to foreigners for the purpose of scientific research (OG 42/08) was adopted, the Committee for Hosting of Foreign Researchers in Croatia has been established by MSES in 2009) many difficulties related to obtaining work permits, residence permits and other terms of foreign citizens' entry and residence in Croatia (Aliens Act, OG 109/03) remain. In order to accelerate the process of mobility and opening of research and HE sector, the [Action plan](#) for overcoming obstacles and enhancing the international mobility in education for the period 2010-2012 has been carried out by the MSES in September 2010.

3.6 International science and technology cooperation

In 2008, the European Commission proposed the [Strategic European Framework for International Science and Technology Cooperation](#) to strengthen science and technology cooperation with non-EU countries. The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting; 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies

worldwide. Having in view these aspects, the following section analyses how national policy measures reflect the need to strengthen the international cooperation in S&T.

3.6.1 International cooperation

Croatia does not have a special strategy for research cooperation with the third countries but it has a long tradition in intergovernmental bilateral agreements on educational, scientific and cultural cooperation with these countries. Most of these agreements dating back to the '80s such as with Japan, India, China and USA, while the agreements with Canada, Russia and Ukraine have been concluded in the late 90s.

The cooperation usually involves the establishment of the joint committee that decides about common research priorities, (e.g. disaster prevention and materials science with Japan), common funds, funding/evaluation research projects, scholarships, exchange of doctoral students, post-doctoral studies in the scientific institutions, etc.

3.6.2 Mobility schemes for researchers from third countries

The mobility schemes for researchers from third countries are part of the bilateral research and educational agreements (see 3.6.1) and usually include scholarships, exchange of doctoral students and post-doctoral studies in the scientific institutions. There is no officially available evidence of the impact of these schemes.

4 Conclusions

4.1 Effectiveness of the knowledge triangle

Table 5: Effectiveness of knowledge triangle policies

	Recent policy changes	Assessment of strengths and weaknesses
Research policy	<ul style="list-style-type: none"> • Reduced government funding for R&D and scholarships for PhD students; • Ensuring quality of research and scientific excellence of RTO and universities (Action plan, 2009); • Enhancing mobility of researchers (Action plan, 2010); • Three important laws: the Law on Science, the Law on Universities and the Law on Higher Education have been proposed in October 2010. 	<ul style="list-style-type: none"> • The main weakness is reduced GERD that could hinder funding of research activities and scientific excellence; it could also direct researchers more towards European and international funds and contribute to the internationalisation of science; • The proposals of the laws foresee huge changes in functioning of the entire higher education and scientific system and despite changes are needed, but there is no consensus regarding the optimal path.
Innovation policy	<ul style="list-style-type: none"> • Orientation towards IPA programmes – Component 3 – regional development like SIIF and BIOCentre. 	<ul style="list-style-type: none"> • The orientation towards IPA regional development is an excellent instrument for better integration of RTO/universities into the local development and closer science-industry cooperation; the main threat is the lack of good project proposals and low involvement of local economy.

	Recent policy changes	Assessment of strengths and weaknesses
Education policy	<ul style="list-style-type: none"> Participation of Croatia in the EU mobility programmes such as Marie Curie-People, EURAXESS and opening scholarships schemes for the Croatian under-graduate and graduate (doctoral) students via Scholarship fair and internet portal; participation of Croatia in the EU programmes of the lifelong learning. 	<ul style="list-style-type: none"> Enlarged mobility helps the integration of the Croatian youth, researchers and teachers into EU and contributes to the supply of foreign researches and Diaspora to the Croatian RTO/universities; however it does not much influence labour supply for researchers in business sector and does not influence the mismatch between enrolment quotas for education programmes with higher employability rates and distortions in the university-educated segment of the Croatian labour market towards SSH.
Other policies	<ul style="list-style-type: none"> Law on Regional Development; Strategy on Regional Development. 	<ul style="list-style-type: none"> The framework of regional development has been defined, which should facilitate competitiveness-enhancing activities (including research), but the framework for funding of regional projects has not been redefined yet.

4.2 ERA 2020 objectives - a summary

Table 6: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
1	Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers	The Croatian Agency for Mobility and EU Programmes has been established in 2007 to take care about mobility with a view of a single EU labour market; the Action plan for overcoming obstacles and enhancing the international mobility in education for the period 2010-2012 was adopted in September 2010; Croatia has become a member of the EU programme for life-long learning on December 7, 2010.	The Agency, the Action plan and the official inclusion of Croatia in the EU LLL should significantly improve circulation of youth, researchers and teachers between Croatia and EU and contribute to the single EU labour market.
2	Increase public support for research	Action plan 2007-2010 set up a target to increase funding for R&D in both the private and public sectors at a rate of at least 25% annually. The goal (was) is to reach a 1:1 ratio of public vs. private sector investment in R&D by 2010.	In reality, the financial and economic crisis reduced the R&D expenditures from 0.9% of GDP in 2008 to 0.83% of GDP in 2009.
3	Increase European coordination and integration of research funding	Croatia is active participant in the joint funds of the SEE-ERA.NET PLUS programme aimed at integrating EU Member States and Southeast European countries in the ERA.	The threat is the lack of national resources for to continuation and expansion of such common funds.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
4	Enhance research capacity across Europe	The participation of Croatian researchers in FP7 is increasing. National contact points (NCPs) are providing support in this regard.	Increasing the participation of the Croatian researchers into the ERA remains the key challenge.
5	Develop world-class research infrastructures (including e-infrastructures) and ensure access to them	The investments into research infrastructure have become the key component of EU funding in Croatia (through the Regional Competitiveness Operational Programme)	Because of the lack of funds and administrative obstacles, the projects often take a long time to develop.
6	Strengthen research institutions, including notably universities	Due to the harmonisation with the Bologna process all the study programmes were reviewed in 2005; the Law on quality assurance in science and higher education system has been enacted in April 2009 (OG 45/2009). A system of internal and external evaluation of research at RTO and universities has been established by the ASHE as the pillar institution of the national system of quality assurance of research system in Croatia. Three universities (out of seven) have quality assurance offices (Zagreb, Rijeka, Split).	The results of evaluation are yet not used a base for institutional funding (such as the government's Research Assessment Exercise for UK). Instead, the present criteria for institutional funding are rather formal and include a number of researchers and their scientific coefficients.
7	Improve framework conditions for private investment in R&D	The Action Plan to encourage investments in science and research set up targets of 15% annual increase of BERD and 20% annual increase of value of R&D contracts between science and industry. Tax incentives provide support to private R&D.	Overall business climate for private R&D investments is unfavourable. The resources of domestic companies are limited, and R&D-intensive FDI have not been attracted.
8	Promote public-private cooperation and knowledge transfer	The key instruments include instrument include joint research projects and industrial PhD research.	The level of cooperation is low and is still hindered by administrative restrictions, lack of joint projects and underdeveloped academic entrepreneurship.
9	Enhance knowledge circulation across Europe and beyond	There are basically two large programmes open to foreign researchers the "Brain gain" programme of the NZZ and UKF programmes that enhance circulation of researchers/knowledge.	The main challenge is to intensify and accelerate the implementation of a number of measures for facilitating incoming of researchers which are under way, such as regulation on temporary residence, health insurance, social security, etc.
10	Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world	International science cooperation is primarily facilitated by bilateral agreements.	Due to limited funds, research cooperation is mostly limited to Europe.

	ERA objectives	Main policy changes	Assessment of national strengths and weaknesses with regard the specific ERA objective
11	Jointly design and coordinate policies across policy levels and policy areas, notably within the knowledge triangle	The Strategic Council for Science and Technology (SVEZNATE) and the National Innovation System Council of MSES (VNIS) has been established to coordinate activities between different ministries involved into the knowledge triangle.	SVEZNATE and VNIS are not fully operational while a number of government bodies and funding agencies lack mutual coordination. The entire strategy of research and technological development remains rather undefined.
12	Develop and sustain excellence and overall quality of European research	Quality assurance mechanisms are being put in place.	Structural problems of the research sector hinder the overall quality of research.
13	Promote structural change and specialisation towards a more knowledge - intensive economy	Industrial and regional policies have been defined; Trade and Investment Promotion Agency was closed down in 2010.	Industrial policy is not transparent; regional policy is not supported by adequate funding mechanisms; FDI attraction does not address the need to specialise towards more knowledge-intensive activities.
14	Mobilise research to address major societal challenges and contribute to sustainable development	The global challenges related to the fresh and sea waters, soil, agriculture, air and climate change are addressed in Croatia by Croatian Environment Agency . Ageing of the society is tackled by demographic studies and studies related to pension system reforms. The new Energy Strategy adopted in June 2009 recognised the EU climate and energy targets by 2020, known as the "20-20-20" targets.	There is a lack of specialised research programmes aimed at major national and global societal changes.
15	Build mutual trust between science and society and strengthen scientific evidence for policy making	The evaluation and accountability culture of the Croatian science and innovation policy is rather modest. The most influential actors on building the trusts are public media which communicate knowledge achievements to wider public.	A long term strategy for supporting mechanisms to build mutual trust between science and society does not exist in Croatia. The impact studies of science and innovation policy programmes on economic development are missing.

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List of Abbreviations

BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
ERA	European Research Area
ERA-NET	European Research Area Network
ERD	Higher Education Expenditure on R&D
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-27	European Union including 27 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP7	7th Framework Programme
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HES	Higher education sector
IP	Intellectual Property
OECD	Organisation for Economic Co-operation and Development
PRO	Public Research Organisations
R&D	Research and development
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
S&T	Science and technology
SF	Structural Funds
SME	Small and Medium Sized Enterprise
VC	Venture Capital