



## Domagoj Račić &amp; Jadranka Švarc

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**Contact information**

Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)

E-mail: [jrc-ipts-secretariat@ec.europa.eu](mailto:jrc-ipts-secretariat@ec.europa.eu)

Tel.: +34 954488318

Fax: +34 954488300

JRC Science Hub

<https://ec.europa.eu/jrc>

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**Abstract**

The report offers an analysis of the R&I system in Croatia for 2014, including relevant policies and funding, with particular focus on topics critical for two EU policies: the European Research Area and the Innovation Union. The report was prepared according to a set of guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites etc. The report identifies the structural challenges of the Croatian research and innovation system and assesses the match between the national priorities and those challenges, highlighting the latest policy developments, their dynamics and impact in the overall national context.

## Acknowledgments

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## Executive summary

The report was prepared according to set guidelines for collecting and analysing a range of materials, including policy documents, statistics, evaluation reports, websites, etc. The quantitative and qualitative data is, whenever possible, comparable across all EU Member State reports.

Croatia is a small country with a surface area of 88,073 km<sup>2</sup>, out of which 56,594km<sup>2</sup> is land area and 31,479km<sup>2</sup> are territorial waters (CBS, 2014). According to the latest Eurostat data, Croatia had 4,262,410 inhabitants in 2013, which is 13,844 less than in 2012. Eurostat projections for 2014 (4,266,700 inhabitants), indicate further downward trend in the number of Croatian population, amounting to 0.84% of total EU population. GDP per capita amounted to € 10,200 in 2013, which is significantly below the EU-28 level (26,600). GDP growth rate in past three years was in constant decline. In 2011 GDP growth rate amounted to -0.2%, followed by decrease in 2012 by -2.2%, and continuation of the trend in 2013 (-0.9%). (Eurostat, 2015)

The total gross domestic expenditure on R&D (GERD) amounted to €354m in 2013. In the past three years GERD was characterized by fluctuation; in 2012 it has decreased to €330m from €336m in 2011. As a percentage of GDP, gross domestic expenditure on R&D amounted to 0.81% in 2013, which was 0.06 percentage points higher in comparison to 2012 and 2011 when it was at the same level (0.75%). (Eurostat, 2014)

The pillar institution of the Croatian science and innovation system is the Ministry of Science, Education and Sports (MSES) which is responsible for the entire research and higher education system, and innovation policy in terms of science-industry cooperation and commercial exploitation of research. Because of the increasing role of entrepreneurship and business ventures in innovation system and access to the European Structural and Investment Funds (ESI) for financing R&I activities the Ministry of Economy, Ministry of Entrepreneurship and Crafts and the Ministry of Regional Development and European Funds acquired increasingly important role in R&I system over the last several years.

The Croatian Science Foundation (CSF) is the funding body for competition-based fundamental scientific research. MSES is responsible for institutional funding organised around the Multi-annual research programmes based on performing indicators. The Business and innovation agency of Croatia (BICRO), the previous pillar institution of the Croatian innovation system has been merged with the Croatian Agency for Small Businesses and Investments (HAMAG) into a single agency called the Croatian Agency for Small Business, Innovation and Investment – HAMAG-BICRO. The Agency implements the programme "Business impulse" – the underlying government programme to encourage small businesses and crafts, which includes support for innovative entrepreneurship and integrates innovation support programmes financed through the [Second Science and Technology Project](http://www.worldbank.org/projects/P127308/second-science-technology-project?lang=en)<sup>1</sup> (a joint project of the MSES and the World Bank).

Main changes that occurred in 2014 can be summarized as follows:

- The landscape of R&I system was significantly changed; majority of traditional and long-lasting funding schemes, institutions and regulations have been significantly

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<sup>1</sup> <http://www.worldbank.org/projects/P127308/second-science-technology-project?lang=en>

reduced or transformed, while the researchers' acquired rights have been revised in order to establish open, transparent and merit-based recruitment;

- The majority of funding instruments and institutions for allocation grants for R&I activities were terminated (all CFS' grants prior to 2013) or re-organized (HIT, BICRO, SIIF, UKF, MSES's project grants;
- Croatian Science Foundation (CSF) remained single funding institutions for allocation research grants for fundamental research;
- External evaluation of research activities and overall management at public research institutes has been carried out in 2014 which faced many institutes with necessary changes in managing research activities in to meet evaluation criteria in the next evaluation cycle;
- The State budget projections foresee further decrease in the State budget for R&I and 2015 and 2016
- In alignment with the decreased State budget, the science policy is directed towards programmes financed by the ESI funds; the new funding programmes have been launched for doctoral students, capacity building in industrial R&D and researchers' mobility;
- The first National reform programme was carried out;
- The Partnership agreement for the European structural and Investment funds in the EU financial period 2014-2020 was adopted;
- Strategy for innovation encouragement of the Republic of Croatia 2014-2020 has been adopted;
- The Strategy for Education, Science and Technology 2014-2020 has been adopted;
- The draft of the Operational Programme Competitiveness and Cohesion 2014-2020 was presented;
- The first national Research and Innovation Infrastructures Roadmap in Croatia 2014-2020 was completed in April 2014;
- S3 (1<sup>st</sup> draft) has been prepared and sent to the European Commission for adoption;
- The enlargement of the Indicative list of research infrastructure project proposals which could be financed from the ERDF has continued; in 2014 it consists of 32 project proposals, of which 22 in science and 10 in education;
- The seven centres of research excellence were established for public support for the first time in Croatia.

This report also provides the analyses of recent developments towards the European Research Area and Innovation Union.

With the Croatian accession to the EU, the transitional and regional cooperation entered a new phase, since transnational cooperation became supported by the ESI funds. In the period 2014-2020, Croatia is expected to participate in 13 territorial cooperation programmes funded through ESI funds, which should significantly contribute to the level of transnational cooperation.

Croatia has regulated market for researchers (Doussineau, 2013). Recruitment and career paths of researchers in Croatia are regulated by national legislation at the level of the central state. The regulations which influence hiring of researchers and their career progression by stipulating conditions for promotion into the higher scientific grades and hiring on corresponding job positions include the Ordinance on conditions for scientific titles adopted by NCSHETD (OG 84/2005) (with sequential amendments) and Conditions of Rectors' Conference for the acquisition of scientific-educational-teaching positions. Universities or even university departments (faculties) and institutions authorized for elections usually determine their internal regulations for electing teachers, scientists and collaborators in scientific titles and corresponding jobs.

When it comes to e-infrastructures and open access to publications and data, Croatia has several e-infrastructures in place, such as [Croatian Academic and Research Network](#)<sup>2</sup> (CARNet), a network of Croatian academic, education (all level) and research community the [University Computing Center](#)<sup>3</sup> (SRCE) which is one of the key subjects in planning, designing and maintenance of the e-infrastructures at the national level. Croatia is also developing a research e-infrastructure within the international cooperation that is part of the European initiative and participates in in the four related projects: [CLARIN](#)<sup>4</sup>, [DARIAH](#)<sup>5</sup>, [ESS](#)<sup>6</sup> and since January 2012 in [SERSCIDA](#)<sup>7</sup>. The national priorities for future infrastructure developments are provided by the [Croatian Research Infrastructure Roadmap 2014-2020](#)<sup>8</sup> adopted on 1 April 2014 by the MSES.

Recent analysis of OA availability (Archambault at all, 2014) revealed that Croatia is among four EU28 countries which have reached an aggregate availability score above 70% together with the Netherlands, Estonia, and Portugal. However, Croatia is one of the member states with the least proportion of green OA (5.2%) while the proportion of Gold OA journal is rather high (23%) and other OA is 38.9%.

When it comes to supporting innovation development, there have been no new mechanisms set up in the form of measures aimed at supporting setting up business angel networks, foster early stage capital funds, seed funds, business angels, corporate venturing and crowd-funding, nor favourable taxation regime for VC and/or business angels. In general, business environment in Croatia is not conducive to innovation. Demand-side policies and instruments stemming towards increasing business investments in research and innovation practically do not exist. Main supporting measures providing incentives for businesses to invest in R&D are tax incentives, with addition of several programmes aimed at funding of innovation activities.

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<sup>2</sup> <http://www.carnet.hr/> (last accessed: 16 February, 2015)

<sup>3</sup> <http://www.srce.unizg.hr/en/> (last accessed:15 February, 2015)

<sup>4</sup> <http://clarin.eu/> (last accessed: 15 February, 2015)

<sup>5</sup> <https://www.dariah.eu/> (last accessed: 15 February, 2015)

<sup>6</sup> <http://www.europeansocialsurvey.org/> (last accessed:15 February, 2015)

<sup>7</sup> <http://www.serscida.eu/hr/> (last ac accessed cess: 15 February, 2015)

<sup>8</sup> <http://public.mzos.hr/fgs.axd?id=21801> (last accessed:15 February, 2015)

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# 1. Overview of the R&I system

## 1.1 Croatia in the European RDI landscape

Croatia is a small country with a surface area of 88,073 km<sup>2</sup>, out of which 56,594km<sup>2</sup> is land area and 31,479km<sup>2</sup> are territorial waters (CBS, 2014). According to the latest Eurostat data, Croatia had 4,262,410 inhabitants in 2013, which is 13,844 less than in 2012. Eurostat projections for 2014 (4,266,700 inhabitants), indicate further downward trend in the number of Croatian population, amounting to 0.84% of total EU population.

According to the Eurostat data, GDP per capita amounted to € 10,200 in 2013 and it is significantly below EU-28 level (26,600). GDP growth rate has continuously declined over the last several years. In 2011, GDP growth rate amounted to -0.2%, followed by decrease in 2012 by -2.2%, and continuation of the trend in 2013 (-0.9%).

The total gross domestic expenditure on R&D (GERD) amounted to €354m in 2013. In the past three years GERD was characterized by fluctuation; in 2012 it has decreased to €330m from €336m in 2011. As a percentage of GDP, gross domestic expenditure on R&D amounted to 0.81% in 2013, which was 0.06 percentage points higher in comparison to 2012 and 2011 when it was at the same level (0.75%) (Eurostat, 2015). This is significantly below the latest R&D investment target, which has been set to 1.4% of GDP by 2020, within the [Economic Programme of Croatia](#)<sup>9</sup> from April 2013, new goal has been set to reaching R&D expenditures in the amount of 1.4% of GDP by 2020. More data on GERD and R&D investment targets is available in section 2.5.1 Funding flows.

## 1.2 Main features of the R&I system

The governance of R&D system in Croatia is centralised at the state level under the authority of the [Ministry of Science, Education and Sports](#) (MSES). Research and innovation activities are mostly funded by the public resources from the central state budget. Funding is based on annual budget cycles proposed by the [National Council for Science, Higher Education and Technological Development](#) (NCSHETD), the highest advisory body in respective domains, and agreed with the MSES and the Ministry of Finance. Since the European Structural and Investment Funds (ESI) acquire increasing importance in R&I funding the budget cycles might be supplemented with the dynamics of ESI funds in the future.

The regional research policy does not exist in Croatia mainly due to the insufficient resources (small tax base) for R&I activities. The regional development policy exists mainly at the county level (NUTS 3) and is related to affairs of local significance such as local economic development, primary education, traffic infrastructure, health services and other social and cultural institutions. Croatia suffers from considerable and long term regional disparities. In the last ten years the average income is three times higher in the richest regions than in the poorest one (RCIC, 2013).

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<sup>9</sup> [http://ec.europa.eu/europe2020/pdf/nd/ep2013\\_croatia\\_en.pdf](http://ec.europa.eu/europe2020/pdf/nd/ep2013_croatia_en.pdf)

According to the [Regional Innovation Scoreboard](#)<sup>10</sup> (EC, 2014), Croatia is a modest innovator while the most developed region is North-West Croatia (due to the capital city Zagreb) which is classified as a moderate innovator. The role of science and research as vehicles of regional development has not been so far adequately articulated. The main legal acts – the Law on Regional Development (Official Gazette 153/2009), the Strategy of Regional Development 2011 – 2013 (adopted in June 2010), and the Strategy of cluster development in Croatia 2011 – 2020 (carried out in 2011) do not deal specifically with regional research capacities. The regional policy is likely to change with the implementation of the Operational Programme "Competitiveness and Cohesion" 2014- 2020 (OPCC, 2014) co-financed by ESI funds which takes into account the regional R&I needs. The success of the Priority axes 1 of the OPCC which aims to *Strengthening through application of research and innovation* will depend on regional involvement and commitment of entrepreneurs who are supposed to play a critical role a R&I regional development.

### **1.3 Structure of the national research and innovation system and its governance**

The pillar institution of the Croatian science and innovation system is the [Ministry of Science, Education and Sports](#) (MSES) which is responsible for the entire research and higher education system, and innovation policy in terms of science-industry cooperation and commercial exploitation of research. Because of the growing role of entrepreneurship and business ventures in innovation system and access to the European Structural and Investment Funds (ESI) for financing R&I activities the Ministry of Economy, Ministry of Entrepreneurship and Crafts and the Ministry of Regional Development and European Funds acquired increasingly important role in R&I system through adopted Strategy for innovation encouragement for the Republic of Croatia 2014-2020 and S3 strategy in development where new structures of governing innovation system are created.

The [Croatian Science Foundation](#) (CSF) is the single funding body for competition-based fundamental scientific research since 1 July 2013 when the allocation of competitive research grants was transferred from MSES to the Foundation. Furthermore, the Unity through Knowledge Fund (UKF) has been affiliated with CSF in 2014 in order to maximise its efficiency. MSES is responsible for institutional funding organised around the Multi-annual Institutional Financing of Research Activities in the Public Research Institutes and Universities based on performing indicators. It is also is the principal administrative body for carrying out programmes in research, higher education and innovation funded by the ESI funds which are becoming the most significant funding resource since Croatia received access in July 2013.

The highest advisory body for the scientific research, higher education and technology is the [National Council for Science, Higher Education and Technological Development](#) established by fusion of previously separated National Science Council (NSC) and the National Council for Higher Education (NCHE).

The Agency for Science and Higher Education (ASHE) is responsible for setting up a national network for quality assurance and evaluation of scientific research and higher education.

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<sup>10</sup> [http://ec.europa.eu/news/pdf/2014\\_regional\\_union\\_scoreboard\\_en.pdf](http://ec.europa.eu/news/pdf/2014_regional_union_scoreboard_en.pdf)

The Business and innovation agency of Croatia (BICRO), the previous pillar institution of the Croatian innovation system has been merged with the Croatian Agency for Small Businesses and Investments (HAMAG) into a single agency called the Croatian Agency for Small Business, Innovation and Investment – [HAMAG-BICRO](#). The merger was a local move to better link up-stream and down-stream interventions. The Agency implements the Proof-of-concept Grant Fund (PoC), the Development of Knowledge-based Companies Programme (RAZUM), the Research and Development Programme (IRCRO) as well as the programme “Business impulse”- the underlying government programme to encourage small businesses and crafts, which includes support for innovative entrepreneurship.

The Croatian government launched in April 2013 the [Second Science and Technology Project](#)<sup>11</sup> (STP II) a joint project of the MSES and World Bank to improve absorption capacity of R&I institutions of the ESI funds. The project will last until July 30, 2017.

Although the private sector is technologically weak and underinvested in the domain of research (0.35% of GDP) it shows in 2013 a trend of growth and exceeds slightly the public sector in both performing (50.1% of GERD) and funding (42.8% of GERD) research activities. However, the public sector largely exceeds the private sector in research manpower since it employs around 85% of total researchers.

The sector of the public research organisations (PROs) consists of 25 public research institutes and around 70 government –funded research units classified as other legal entities (e.g. hospital research centres). The sector of higher education institutions consists of 87 higher education institutions: 7 universities (six public and one private university), 72 components of public universities (faculties, academies and departments), 4 high schools (two public and two private) and four public colleges. There are around 14 private research organisations which are either independent institutes (e.g. the Mediterranean Institute for Life Sciences) or belong to corporations (e.g. Ericsson Nikola Tesla). Several small research-based companies occurred in the last years like GENOS (biomedicine).

In the private business sector R&D is concentrated in a few large multinational companies like PLIVA (pharmaceuticals), Ericsson-Tesla Institute (telecommunication), Podravka (food industry) and Končar – Electrical Engineering Institute. Medium and large enterprises invest more than 90% of private investments in R&D, while large enterprises invest highest portion, more than 60% of R&D investments. Little less than 8% of private investments in R&D come from micro and small enterprises, thus showing their weak engagement in R&D activities (OPCC, 2014).

The innovation potentials in production sectors are coming mostly from technological mastering and business sophistication in SMEs in medium-low and medium-high tech sectors which made around 48% of a total of 11,560 SMEs in the manufacturing sector. Another 4.6% or more than 500 firms are classified as high-tech (MEC, 2013). FDI have not brought new technologies since the majority of FDI is realized in wholesale trade and commission trade followed by financial intermediation trade. The Croatian economy is a service-oriented economy, i.e., services account for 68.1% of GVA which are concentrated (with the exception of financial intermediation), in low-tech services like wholesale and retail trade, transport, storage and communications which do not require R&I (Bečić and Švarc, 2010).

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<sup>11</sup> <http://www.worldbank.org/projects/P127308/second-science-technology-project?lang=en> (last accessed: 15 February, 2015)

The national R&I system and policy mix to stimulate research in innovation has remained quite stable in the period 2010-2012 despite some setbacks in implementation of the measures due to the budgetary financial constraints and expiration of the World Bank loan that served to co-finance the UKF and selected BICRO's programmes (e.g. PoC, RAZUM, IRCRO, TEHCRO). By contrast to this stable period, the R&I system has been substantially changed by far-reaching reforms initiated in 2013 that came into full swing in 2014. The reforms were driven by the need to improve the efficiency of rather inert and stagnant research and higher education systems and by excessive public deficits which require cutting down the budget for R&I. The reforms brought many changes not only in funding but also in organisation, governance, performing and evaluation of R&I activities. Many institutions and programmes for supporting research based innovation which were developed for over a decade were terminated or transformed (e.g. BICRO, UKF, and HIT).

The funding of research institutions and projects has been also substantially changed by transferring allocation of research grant from MSES to CFS which remained a single source for funding competition based fundamental research. The main improvements were carried out in the area of institutional funding by introducing performance-based indicators and external evaluation of research activities at HEIs and PROs. Finally, there is a general trend of replacing national resources with the ESI funds and directing the research policy initiatives towards programmes tailored by the requirements of the ESI funds.

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#### **Main changes in 2010**

*The R&I system has not been changed significantly in 2010: the three laws for reforming R&I and higher education systems proposed in October 2010 have not been adopted;*

*The GERD, state budget and funding for scholarships for PhD students were significantly reduced;*

*The R&I policy changes were focused on international mobility and participation of researchers in the EU FP which resulted in adoption of the three action plans in this respect ;*

*Croatia has become a member of the EU programme for life-long learning on December 7, 2010;*

*The IPA funds were growingly used for co- funding large scale programmes such as BIOCentre and technology transfer programme - the Science and Innovation Investment Fund (SIIF);*

*The legal status of BICRO has been changed from company with limited liability into an innovation agency with the status of public institution which resulted in the decrease in budget for programmes and reduced salaries of staff;*

*BICRO has expanded its programmes with a new one - Proof of Concept that achieved success.*

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#### **Main Changes in 2011**

*There were no significant changes in R&I system, the general institutional and programme set up from the previous period was rather stable and partly expanded with the measures focused on scientific excellence and internationally competitiveness ( the CSF launched two new programmes in this context, the Research projects and Collaborative research programmes);*

*The next policy focus was on alignment with the ERA priorities especially in the area of labour market for foreign researches by removing administrative barriers, strengthening participation and knowledge circulation through ESFRI initiatives (DARIAH, CLARIN, ESS) and knowledge circulation through the EU mobility programmes such as Marie Curie-People, EURAXESS;*

*The uncertainty of budgetary resources for programmes has increased due to the severe fiscal constraints.*

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**Main changes in 2012**

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The new government elected in December 2011 has initiated many reforms in both R&I system and in surroundings in order to improve business climate and to eliminate the structural rigidities that hamper the country's growth potential including efficiency of the innovation and research system;

The reforms in R&I were based on the Draft of the law amending the Law on Science and Higher Education from 2003; the reforms will come into full swing during 2013 and 2014;

The allocation of research grants was transferred from the MSES to the Croatian Science Foundation stipulated by the Law on Amendments and Supplements of CSF (OG 78/2012) which will fundamentally change the system of research funding in the forthcoming period;

The new strategic documents were drafted, primarily the National Strategy for the Croatian innovation development 2013-2020, and the Guidelines for strategy of teaching, education, science and technology;

The reforms have started the process of shrinking the innovation system in both institutions and programmes; the beginning is marked by the fusion of HIT with the BICRO;

The realisation of the BICRO's programmes like RAZUM, TECHRO or IRCRO was slowed down while UKF programmes, despite international recognition, were partly terminated due to the lack of budget resources;

On the eve of Croatia's EU accession an expert group for carrying out the Smart Specialization Strategy is appointed by the Ministry of economy;

The first evaluation studies of the innovation supporting programmes were carried out by the World Bank and the Institute of Economics from Zagreb.

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**Main changes in 2013**

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Croatia became the 28th member of the EU on 1 July 2013 which provided Croatia with an access to the European Structural and Investment Funds(ESI);

Croatian Science Foundation (CSF) has become a principal (and single) funding institutions for allocation research grants for fundamental research; the number of projects were reduced by ten times in order to strengthen competitiveness;

Institutional funding of research activities at PRO and HEI was transformed from the formal system based on number of researchers into the performance-based funding;

Research institutions gained more autonomy and responsibility in spending allocated resources which relates to more accountable institutional research policy and management;

Promotion of scientists into higher scientific grades were tightened; scientific titles are separated from the job positions;

Programme for establishing of the centres of research excellence (CORE) was launched for the first time in June 2013;

The Smart Specialization strategy was in progress with the assistance of EU co-funded team of experts;

Preparation of the Indicative list of infrastructural projects for ERDF is underway.

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**Main Changes in 2014**

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The landscape of R&I system was significantly changed; majority of traditional and long-lasting funding schemes, institutions, regulations and researchers' acquired rights have been significantly reduced, transformed or simply swept out;

The majority of funding instruments and institutions for allocation grants for R&I activities were terminated or re-organized (HIT, BICRO, SIIF, UKF, MSES's project grants, all CFS' grants prior to 2013);

Croatian Science Foundation (CSF) remained single funding institutions for allocation research grants for fundamental research;

External evaluation of research activities at public institutes has been carried out in 2014 which faced many institutes with necessary changes in managing research activities in to meet evaluation criteria in the next evaluation cycle;

The CFS's Action plan 2013-2014 and the projects of the State budget projections foresee further decrease in the State budget for R&I and 2015 and 2016

In alignment with the decreased State budget, the science policy is directed towards programmes financed by the ESI funds; the new funding programmes have been launched for doctoral students, capacity building in industrial R&D and researchers' mobility;

The first National reform programme was carried out;

The Partnership agreement for the European structural and Investment funds in the EU financial period 2014-2020 was adopted;

Strategy for innovation encouragement of the Republic of Croatia 2014-2020

The first national Research and Innovation Infrastructures Roadmap in Croatia 2014-2020 was completed in April 2014;

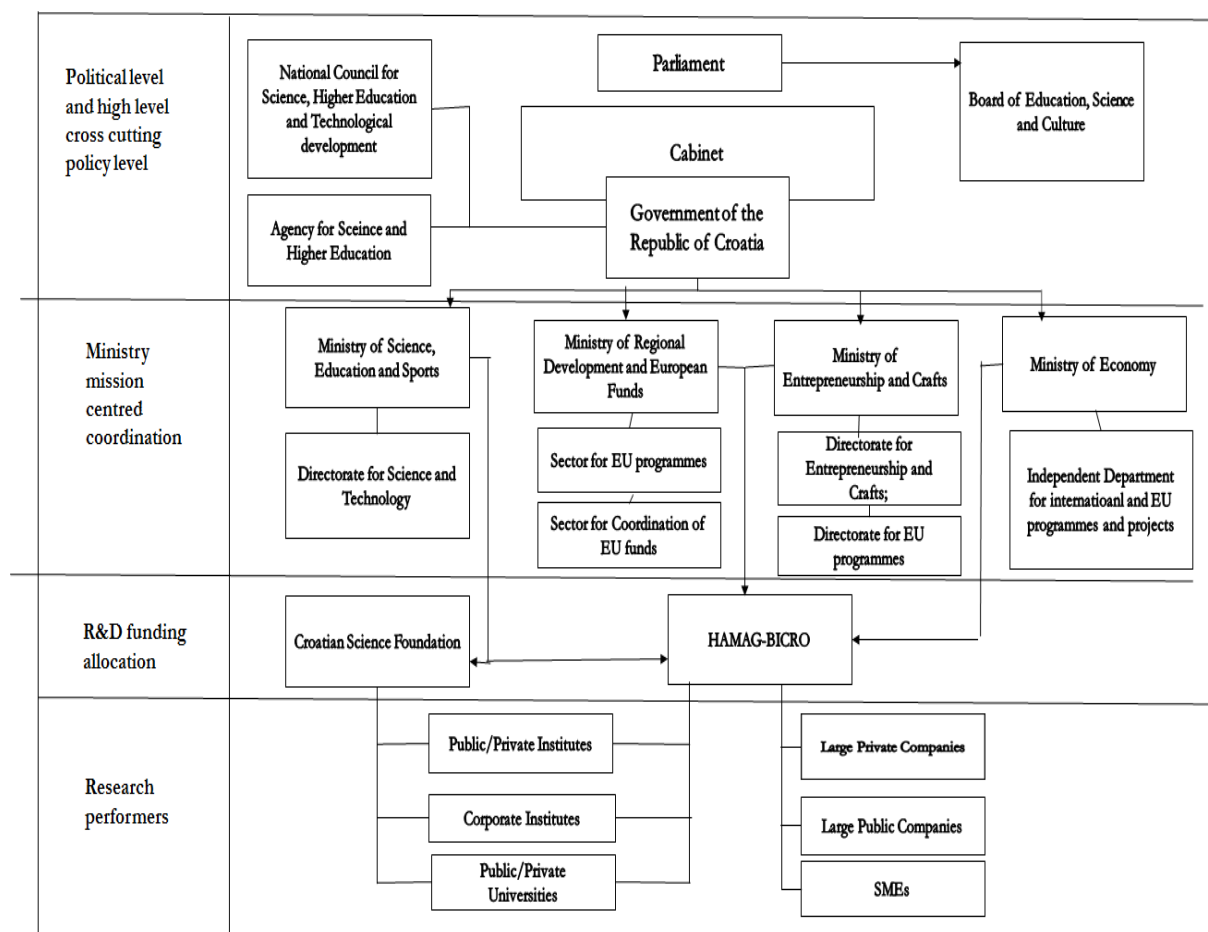
S3 is prepared to be sent to EC for adoption;

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The Second Science and Technology Project (STP II) a joint project of the MSES and World Bank has been launched in April 2013;

The preparation of the Indicative list of infrastructural projects which could be financed from the ERDF is continued; in 2014 it consists of 62 project proposals, of which 44 in science and 38 in education;

The seven centres of excellence were adopted for public support for the first time in Croatia.



**Figure 1 Organogram of the research and innovation system**

## **2. Recent Developments in Research and Innovation Policy and systems**

### ***2.1 National economic and political context***

Croatian economy has experienced strong downturn under the influence of global financial and economic crisis. In the period from 2002 to 2008 high macroeconomic growth in Croatia was mainly induced with domestic demand. In this period average annual rate of GDP increased by 5%, and then was followed by full five years of economic recession that brought economic downturn. Namely, a sharp GDP decline of -7.4% was recorded in 2009, and continued to decline through 2010 (-1.7%), 2011 (-0.3%), 2012 (-2.2) and 2013 (-0.9%). According to the Croatian Bureau of Statistics, the quarterly GDP for the second quarter of 2014 decreased in real terms by 0.8% as compared to the same quarter of 2013. According to IMF's [World Economic Outlook](#)<sup>12</sup> (October 2014) Croatian economy expects to decline by 0.8% in 2014, and to grow by 0.5% in 2015. While all major demand components are still weakening, fiscal and monetary policies have limited capacities to provide an effective stimulus to the economy due to financial stability concerns. Since 2009, Croatia has further increased the convergence gap with the EU10 and EU15 countries

Croatia became the 28th Member State of the European Union on 1 July 2013. While EU accession may be expected to provide support for the economy, in the very short term the crosscurrents problems in the Croatian economy will remain a major drag on growth. With the EU accession, new opportunities are arising for Croatia, particularly through access to EU markets and increased funding for innovation. Since the beginning of the 2014, Croatia became a subject to the EDP (Excessive deficit procedure), which will have a sizable impact on fiscal and economic policies.

The centre-left Government elected in November 2011 has started significant economic reforms e.g. reducing budget deficits, increase of VAT at 25 %, change of personal income tax, registration of a company with only €1.3 of founding capital, increasing VAT inter-rate, introducing fiscalisation etc. Unfortunately, these reforms and the lack of investments failed to reverse the negative economic trends caused by the long-term neglect of structural reforms, particularly slow growth of foreign direct investments and crisis in the Eurozone. These negative trends and unstable business environment also induced adverse effects on research and innovation budgets. The deep economic downturn coupled with cost-cutting policy and strong financial discipline takes its toll not only on spending and employment but has a negative feedback of R&D financing and future prospects.

The process of transformation towards a market economy brought a deep structural change that had a strong impact on the labour market in Croatia, as in all of the transitional countries. Now, after more than twenty years of transition, the Croatian labour market is still not performing well and it is troubled by low participation and employment rates and, at the same time, with high unemployment rates. In the period from 2008 to 2013 the registered unemployment rate has grown cumulative by 7%. Seasonally adjusted unemployment rate in Croatia was 16.5% in August 2014, according to the Eurostat. Current situation on Croatian labour market is characterized by low employment, high inactivity rate (war veterans, retired people) and long-term unemployment. One of the

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<sup>12</sup> <http://www.imf.org/external/pubs/ft/weo/2014/02/pdf/text.pdf>

main structural weaknesses in Croatian labour market is a mismatch between labour demands and offers. This has been acknowledged by the Croatian Employment Service (CES) in its recommendations to introduce changes in educational enrolment and scholarship policies which will contribute to the harmonization of education and labour market needs, and reduce the structural mismatch between supply and demand. The job losses in the last six years of economic downturn (170,000 jobs have been lost) were concentrated in construction and manufacturing which hardly can be absorbed by new sectors needed for economic recovery like service and higher added value sectors.

High unemployment is combined with the high level of youth unemployment (aged 15-24). Croatia is the 4th EU country with the highest share of young unemployed persons reaching 43.9% in the second quarter 2014 (Eurostat, 2014) while the first is Spain with 53.7% followed by Greece with 51.5% and Italy with 44.2%. A share of unemployed persons with higher educational level in Croatia is 11.89% of the total number of unemployed which indicates a strong need for reforms not only of labour market but also in the higher education sector. Croatia's high rates of youth unemployment and long-term unemployment can be partially explained by the lack of a quality structured incentives and rigidities in the labour market. Generally, there is a challenge to improve the quality of labour market, decrease the level of youth unemployment, and increase participation in lifelong learning and to improve the quality for all levels of education.

The doctoral students (who are usually perceived as human resources for knowledge economy) with the expiring employment contract in public sector (HEIs and PROs) will face significant difficulties to find job in the private sector after graduation. The budget cuts and recent reforms of research sector do not allow them to stay in the public sector which was previously a regular practice. Therefore, it is important to explore possibilities for job creation, including self-employment and entrepreneurship.

The aggregate data on business R&D expenditures has historically been worryingly low and continues to further decrease. This problem, along with the budget cuts for research and negative economic trends, represents one of the largest challenges for creating efficient innovation policy. While research and innovation are at the heart of the Europe 2020 strategy for growth and jobs, Croatia's gross domestic expenditure on R&D has declined substantially, reaching its low point of 0.75% of GDP in 2012, with only 0.34% of GDP invested by the business sector, while EU average is 1.31%; this indicates a substantial lack of critical investments for technological accumulation and global competition based on knowledge and innovation.

The collapse of large state owned enterprises in the manufacturing sector during privatization and their link with research organizations, including the unfavourable structure of SMEs which is dominated by sectors not based on research and innovation, are considered to be the main reasons for the weak business research. Major weaknesses of business sector include:

- low investment in R&D,
- weak absorptive capacities of Croatian businesses,
- the lack of linkages between innovation actors,
- the strong concentration of R&D expenditure on relatively few companies while innovation and R&D occupy a marginal role in the development strategies of the most of Croatian companies.



Links between science and industry are still weak, despite the relatively developed infrastructure for R&D. Also, there is a lack of incentives for cooperation between science and industry, including commercialization of R&D. Croatian R&D&I system is characterized by the lack of the strategic development visions which would promote research and innovation as the pillars of development. Although R&D is emphasised as the key prosperity factor for economic development, in Croatia there is still lack of funding which has been justified by other priorities, such as large capital non-productive investments (e.g. sports arenas), subsidies to failed industries (shipyards, railways) and agriculture (five-fold of the EU15). The scarcity of resources for R&D in 2013 is justified by the new subsidies to shipyards, EU membership fee, interest on state loans, increase of pension funds, salaries in the public sectors and other factors.

The trends in R&D funding reveal that both public and private investments in research and innovation are fairly small and have worryingly downward trends. Research and innovation are not only constantly under-invested (below 1% of GDP) but further budget restrictions and financial crisis threaten the maintenance of the national knowledge base, professional expertise and education.

Croatia as a new member state of European Union will have greater availability of EU funds, but also this might not ensure prosperity of economy. A next task for Croatia as an EU member state is to implement reforms which will create adequate absorption capacities for EU funds and improve innovation policy. This membership will certainly influence on future evolvement of research and innovation and provide a new momentum for Croatian economic development and financial stability.

## ***2.2 National R&I strategies and policies***

The governance of the R&I systems has gone through turbulent times since mid-2013 due to the significant reforms in both research and innovation system in pursuit of scientific excellence, innovation efficiency and reducing budget resources for R&I. The austerity policy caused by the sixth consecutive years of economic contraction and excessive public deficits resulted in significant changes not only in funding but also in the organisation, governance, performing and evaluation of R&I activities. A majority of traditional and long-lasting funding schemes, institutions, regulations and researchers' acquired rights have been significantly reduced, transformed or simply swept out. The reforms have received, despite certain improvements and advancements in the governance of the research and higher education systems, many critics as being chaotic and detrimental for R&I. Most notably, the budget cut-offs for scientific research and reduction in wages produced many uncertainties and dissatisfactions in the scientific community which has culminated with the dismissal of the Minister of Science, Education and Sports.

The State budget for 2014 and projections for 2015 and 2016 envisage reduction instead of an increase in public resources for R&I, which diminishes the financial sustainability of R&I systems and policy. However, Croatia received a remarkable opportunity to address the needs in research, innovation and skills by the EU membership which gives Croatia access to the EU Structural and Cohesion Funds with a fund of €1.5 billion annually in the period 2014-2020 (World Bank, 2014). The appropriate use of the funds is highly dependent on the capacity of public administration to absorb and manage the allocated EU funds. It will certainly require not only substantial reforms in public administration in the coming years

but also acceleration of long-term neglected structural and fiscal reforms which remain a major impediment to research, innovation and overall growth.

The legislative framework that marked the beginning of the systemic changes in R&I and higher education systems consists basically of the three acts: the Act on Amendments to the Act on Science and Higher Education (OG, 94/2013 and OG 139/2013), Law on Amendments and Supplements to the Croatian Science Foundation (OG 78/2012), and Act on Quality Assurance in Science and Higher Education (OG 45/2009).

The main stakeholders involved in the evolution of R&D system are institutions responsible for efficient and sustainable R&D system, primarily MSES, NCSHEDT, ASHE and CSF, then representatives of HEIs and PROs and eminent scientists. The involvement of remaining stakeholders (industry, NGO, local/regional authorities) regarding organization and funding of research activities is rather weak due to the traditional closeness of research community and centralized governance at the state level. However, a wider range of stakeholders is usually involved in the preparation of documents of a broader national significance such as the various strategies, action plans, etc. They usually participate through consultations, public hearings or direct involvement in documents' preparation. Many research institutions plan to intensify cooperation with business, public, civil sector and society at large, in order to promote and encourage science and knowledge society culture, networking, cooperation and science promotion.

The most noteworthy change relates to the new model of financing scientific activities from the State budget that includes two main components. The first component refers to the allocation of the competition based research grants which is transferred in the second half of 2013 from the MSES (the practice being in force since 1991) to the [Croatian Science Foundation](#) (CSF) and assumes a strict evaluation process that should result in a small number of high quality research projects (around 20% of proposals). The CSF has become a principal and, in the absence of other sources, the only public funding agency dealing with fundamental research. The main intention of this reform was to terminate the current practice of financing a large number of low-competitive scientific projects and high acceptance rate (more than 80% of proposed projects) in order to reach a critical mass of researchers and resources that could yield significant scientific results. According to the Action plan of the CFS 2013-2014<sup>13</sup> ([Action plan for announcing public call for proposals for research projects from July 2013 to July 2014](#), adopted in September 2013) only 200 projects per year will be accepted for financing within the two types of research programmes: /1/ "[Installation research projects](#)" for early career researchers to encourage them to establish their own research groups (50 projects in total) and "[Research projects](#)" for senior and all other scientists to enhance their international competitiveness and mentoring competences (150 projects in total).

The [Croatian Science Foundation](#) (CSF) has itself undergone significant organisational and programme changes when the new model of research funding came into force as stipulated by the Law on Amendments and Supplements to the Croatian Science Foundation (OG 78/2012). The foundation has taken over the allocation of the competition based research grants from the MSES while all the previous programmes of CSF were terminated such as training of doctoral students, international mobility programmes (e.g. Brain gain programmes, EMBO), research partnership with industry, etc.

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<sup>13</sup> <http://www.hrzz.hr/UserDocsImages/pdf/Akcijiski%20plan%20HRZZ.pdf>

The Action plan of CFS foresees the balanced development of all scientific disciplines and fields without thematic prioritization. In some cases bottom up project proposals coincide with the societal challenges, but there is no top down definition of thematic areas (including societal grand challenges). For example, ageing of the society is tackled by demographic studies and studies related to pension system reforms.

However, the societal challenges have been addressed by the draft of the Smart specialization strategy which identifies five cross-cutting priority themes in research and connects them with relevant societal challenges; the first priority - Health involves societal challenges related to health, demographic change and well-being; the second priority - Energy and sustainable environment involves societal challenges related to secure, clean and efficient energy, climate action, environment, resource efficiency and raw materials; the third priority Transport and mobility involves societal challenges related to smart, green and integrated transport and secure societies - protecting freedom and security of Europe and its citizens; the fourth priority - Security involves societal challenges related to cyber security; defence dual-use and mine action programme; the fifth priority Agro-food and Bio-economy involves societal challenges related to food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy.

Among future megatrends and societal challenges Croatia disposes potentials in the specific area of biomedical technology and subdivisions (e.g. infectious diseases, heart and vascular diseases, brain research, tumour diseases, human reproduction, public health, gene and tissue transplantation, stomatology, animal health, etc.). The research potentials are located in the leading medical and research organizations such as School of Medicine, Zagreb, School of Medicine, Split, Faculty of Pharmacy, Faculty of Medicine Osijek, Institute Rudjer Boskovic, University of Rijeka - Department of Biotechnology, Croatian Academy of Sciences and Arts, Genos (Spinout for the University of Zagreb Medical School), Faculty of Science, Zagreb, Institute for Medical Research and Occupational Health, Zagreb, etc.

Total funds allocated to CSF in 2014 amounted to around €13m and the same amounts are envisaged by the State budget in the next two years, for 2015 and 2016. The low level of envisaged resources seriously undermined the needs of fundamental research in Croatia and left many excellent and perspective research groups without funds. It could threaten and reverse the initial goals of the programme focused on strengthening of research excellence. Therefore, it remains to be seen whether this new type of research funding will be sustainable or it will endanger a relatively small science base in Croatia (about 6,400 researchers in FTE or 47% of average in the EU-28). It is often forgotten that Croatia has a relatively narrow financial base for scientific research due to the technologically weak private sector and a lack of diversified resources for competitive research funding. With the exception of possible resources from the EU funds, the Croatian Science Foundation is currently a single national funder of R&D which is assigned a task of preservations and developing of a "national science base". This base relies mainly on the public R&D sector which nowadays employs 85% of the Croatian research labour force and makes a ground for overall international knowledge transfer and research-based development.

The second component of reforms in funding schemes refers to the establishment of a new model of institutional funding based on performance indicators. It was launched by the new Act and the Decision on the Multi-annual institutional funding for research programme in public research institutes and universities 2013-2015, which was adopted on 6 June 2013 (Official Gazette 69/2013). The amount of institutional funding depends

on the institutional performance indicators that are evaluated during the first six months of 2013 and agreed between the MSES and PRO/HEI on a three years basis. In the future it will depend on the results of external evaluations. The [performance-based funding](#) will certainly contribute to the autonomy and responsibility of universities and research institutes in deciding on internal distribution of allocated financial means for improving research activities in order to meet evaluation criteria such as international competitiveness, scientific recognition, high-quality publishing, research results and outcomes with the impact on socio-economic potentials, etc. The total funds allocated by the State budget amounts to around €6.6m in 2014 and the same amounts are envisaged by the State budget in the next two years, for 2015 and 2016. 85% of these resources were allocated to the seven Croatian universities while 26 public institutes received only 15%<sup>14</sup>. The universities have established the Fund for the development of universities and carried out a public call at the universities' level for research projects to allocate the given resources. The systemic and integrated data on granted funds are presently missing.

The innovation system for fostering research-based innovations and technology-based companies has also undergone tremendous changes since the Business Innovation Agency of the Republic of Croatia (BICRO), a pillar institution of the Croatian innovation system and reference institution in the region for funding early stage innovations (created by merging the Business Innovation Center (BICRO) and the Croatian Institute of Technology (HIT) in January 2013. It has been merged with the Croatian Agency for Small Businesses and Investments (HAMAG) into a single agency called the Croatian Agency for Small Business, Innovation and Investments – [HAMAG-BICRO](#). The single Agency was established in May 2014 stipulated by the Law on Amendments to the Law on the Promotion of SME Development (OG 56/2013) with a view to simplify the process that an entrepreneur should pass from the initial business idea to its commercialization. Unification is driven by the idea to combine BICRO's experience in supporting innovative businesses with the HAMAG-INVEST's experience with the implementation of the guarantee schemes and attracting investments. The HAMAG-BICRO is today a large agency with little bit less than a hundred employees. It is assigned a special role in the implementation of the Europe Strategy 2020 and in the absorption of Structural funds within the Thematic objective 1 - Strengthening research, technological development and innovation (Ministry of Economy) and Thematic objective 3 – Enhancing the competitiveness of small and medium-sized enterprises (Ministry of Entrepreneurship and Crafts).

The Agency implements the programme "[Business impulse](#)" - the underlying government programme to encourage small businesses and crafts, which includes support for innovative entrepreneurship. The programme is funded from the EU Structural funds and national resources with a total budget in 2014 of €46m. It is expected that the BICRO's programmes will be integrated and strengthen within the Business impulse programme.

The main policy documents of R&I include the Strategy for innovation encouragement of the Republic of Croatia 2014-2020, the Strategy for Education, Science and Technology, the Smart specialisation strategy and the Research and Innovation Infrastructures Roadmap in Croatia 2014-2020. Development of strategic documents involved wide public consultations and a broad range of experts. During 2013 and 2014, the MSESs conducted

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<sup>14</sup> According to the MSES announcement, available at:  
<http://public.mzos.hr/Default.aspx?art=12597&sec=1933>.

consultation with the interested public and the social partners regarding the adoption of the proposed documents which proved to be an excellent practice of open dialogue and partnership with interested public and private partners.

The [Strategy for innovation encouragement of the Republic of Croatia 2014-2020](#)<sup>15</sup> entails a list of strategic goals for reforming research system which are currently composed of the four thematic pillars and around 40 guidelines for their implementation. The main strategic objective is to increase the social welfare and competitiveness of the Croatian economy based on knowledge, creativity and innovation. The thematic pillars include: /1/ Development of the innovation system and the Croatian legal and fiscal framework to encourage innovation, /2/ Strengthening the innovation potential of the economy, /3/ Encouraging cooperation and flow of knowledge between business, the public and the scientific research sector, /4/ Strengthening of human resources for innovation and enable the creation of an attractive environment for world-class researchers. The Strategy has been adopted in December 2014.

The new [Strategy for Education, Science and Technology](#)<sup>16</sup> has been adopted by the Government of Croatia in October 2014 (OG 124/2014). The Strategy is very comprehensive and mainly focused on all levels of educational system from primary to higher education, and adult education, as well. The last part is devoted to science and technology and emphasise the six objectives, such as /1/ changes in the higher education and science strategic management; /2/ creation of the internationally competitive HEIs and PROs that create new scientific, social, cultural and economic value; /3/ creation of an environment that encourages interaction, cooperation and transfer mechanisms between the research community with innovative economy and social activities; /4/ involvement of HEIs and PROs in the process of smart specialization and associated technological development; /5/ development of the national research and innovation infrastructure with public access, with the inclusion of the European infrastructure and connections; and /6/ improving the system of public funding and encouraging investments of business and social sectors in research and development.

The Smart Specialisation Strategy for Research and Innovation (S3), currently under development, will present the central strategy according to which Croatia will structure, prioritise and position its EU Structural and Cohesion Funds (see Chapter 2.6).

The first national [Research and Innovation Infrastructures Roadmap in Croatia 2014-2020](#)<sup>17</sup> was completed in April 2014 with the purpose to direct further development and investments in research infrastructures according to the scientific fields which are of greatest potentials for development and growth and with respect to the remaining national strategies of research, higher education and innovation. The roadmap is taking into account the developments of the pan-European scientific research infrastructures and plan further participation in the EU initiatives like GEANT, MERIL, ERIC, etc.

In addition to the strategies focused on R&I, there are other strategies on the national level which are also highly relevant for R&I policies. They include primarily the National reform programme (see Chapter 2.3), Convergence programme with the EU and the Partnership

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<sup>15</sup> [http://www.mingo.hr/public/documents/Strategija\\_poticanja\\_inovacija\\_18\\_12\\_14.pdf](http://www.mingo.hr/public/documents/Strategija_poticanja_inovacija_18_12_14.pdf) (last accessed: 16 February, 2015)

<sup>16</sup> <https://www.azvo.hr/hr/novosti/1061-strategija-obrazovanja-znanosti-i-tehnologije> (last accessed: 16 February, 2015)

<sup>17</sup> <http://public.mzos.hr/fgs.axd?id=21801> (last accessed: 16 February, 2015)

Agreement (PA, 2014) that has been officially submitted by Croatia to the European Commission in April of 2014 and the Strategy for entrepreneurship development in Croatia 2014-2020. Since in Croatia there is currently no umbrella strategic document for the period 2014-2020, these documents build the backbone of the future strategic directions of the national developments.

The [Partnership agreement for the European Structural and Investment funds in the EU financial period 2014-2020](#)<sup>18</sup> adopted by the Commission on 30 October 2014 (PA, 2014) identifies the most important development challenges that Croatia is facing and define the main funding priorities in the context of usage of the European Structural and Investment Funds (ESI). The PA states that the main structural deficiency in the R&I area is related to weak governance of the national innovation system and lack of an integrated policy framework for R&I embedded in Croatia's mainstream development strategies. Strategic objectives in relation to the main funding priority and main expected results related to R&I through the ESI involve: /1/ Promotion of research excellence; /2/ Improving science industry collaboration and technology transfer; /3/ Stimulating business R&D and innovation and the creation and growth of knowledge based start-ups; /4/ Improving the governance of science, research and innovation policies in order to increase the impact of public expenditure in R&D.

The ESI funds shall contribute to national strategic goals in R&I in mainly three areas: /1/ to substantively increase amounts of public support, especially in business investments in R&D (e.g. through the direct support to SMEs, R&D projects and knowledge based start-ups, i.e. the type of support that BICRO provides, as well as support to R&D projects and R&D capacity building of large enterprises, /2/ to enhance cooperation between academia and business and industry and /3/ to strengthen research performance and support scientific excellence in public R&D in areas of smart specialisation (e.g. by promoting modern research infrastructure, career prospects for top scientists, research collaborations, etc.).

Thematic or sectoral R&D policies currently do not exist in Croatia in fundamental sciences since the CFS is obliged by the Law on CSF to support all fields of science in the same footing. There was only one thematic programme for [Strengthening capacities for research, development and innovation](#)<sup>19</sup>, which was launched in January 2014, with a focus on applicative and industrial research and co-financed by the ERDF through OP Regional Competitiveness.

Most of the GBAORD in 2012 has been allocated to the general advancement of knowledge (48.5% from GUF and 44.6% from other sources than GUF), while the remaining 6.9% was distributed among other priorities, such as Agriculture (0.5%), Health (0.9%) and Industrial production and technology (1.1%).

The new programmes mainly funded from the EU funds have been initiated, as follows:

- The Programme [Strengthening capacities for research, development and innovation](#) was launched in January 2014 with a focus on applied and industrial research which should be realized in cooperation between research institutions (applicant) and industrial/business partners in order to achieve results with potential

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<sup>18</sup> [http://www.mrrfeu.hr/UserDocsImages/EU%20fondovi/PA\\_OFFICIAL%20PROPOSAL\\_CROATIA.pdf](http://www.mrrfeu.hr/UserDocsImages/EU%20fondovi/PA_OFFICIAL%20PROPOSAL_CROATIA.pdf) (last accessed: 16 February, 2015)

<sup>19</sup> <http://public.mzos.hr/Default.aspx?art=12962>

commercial applications or the creation of new relevant knowledge. The programme is co-financed by the European Regional Development Fund (ERDF) within the Operational Programme for Regional Competitiveness (RCOP) 2007-2013, Measures 2.2. - Research, development and technology transfer. The total indicative budget of the Call is €9.3m out of which the contribution of the ERDF amounts to €7.9m and national contribution amounts to €1.4m. In this call the maximum grant amounts to around €1m and the minimum grant amounts €0,2m. Percentage of project financing is up to 100% of the total costs of the applicants and up to 80% of the total cost of partner;

- Programme "[Research scholarships for professional development of young researchers and post-doctoral students](#)"<sup>20</sup>. The Programme is carried out within the Operational programme 'Human Resources Development', Measure 3.2 Development of human resources in research and development. It is aimed at strengthening research and entrepreneurial competencies of young researchers and post-docs and to create conditions for their integration into the European Research Area through mobility. A total fund of €4.9m is provided from the European Social Fund (85% and from the State Budget (15%).

The programmes funded from national and EU research funds involve:

- Programme "[Young Researchers' Career Development Project – Training of Doctoral Students](#)"<sup>21</sup> is coordinated by the Croatian Science Foundation and funded by the State budget. The main goal is to enable scientifically active mentors to involve in their research projects young researchers with the aim to train new doctoral students who will continue their career in cutting-edge science or new technologies in the economy. The call has provided funding of annual gross salary, in the form of grants that will cover two periods, each lasting two years. The first part includes doctoral study and submission of the doctoral thesis topic while the second involves (upon positive evaluation of the proposal) the completion of the doctoral thesis. The total funds for the 2014 amount to €3.9m (manly for gross salaries);
- Programme for establishing of the [centres of research excellence](#) <sup>22</sup>(CoRE) was launched in June 2013 with the aim to identify research groups of international relevance with the potential in frontier research and cutting-edge science; an amount of €0.3m per year was earmarked in the State budget for 2014, 2015 and 2016 while the additional funds will be provided by the EU Structural funds; the National Council for Science, Higher Education and Technological Development (NCSHETD) approved in November 2014 seven centres of excellence, as follows: in natural sciences: /1/ the Centre of Excellence for Advanced Materials and sensors (CEMS), /2/ the Centre of Excellence for Science and Technology (STIM); in the field of biomedical sciences: /3/ the Centre of Excellence for Reproductive and Regenerative Medicine and /4/ the Centre of Excellence for Viral Immunology and Vaccines; in the field of humanities: /5/ the Centre of Excellence for Integrative Bioethics and /6/ the Centre for Croatian Glagolitic script; in the field of social sciences: /7/ Research Centre for School Effectiveness and Management;

<sup>20</sup> <http://public.mzos.hr/Default.aspx?art=13330&sec=2127>

<sup>21</sup> <http://www.hrzz.hr/default.aspx?id=1171>

<sup>22</sup> <http://www.zci.hr/>



- Programme “International Fellowship Mobility Programme for Experienced Researchers in Croatia – [NEWFELPRO](#)”<sup>23</sup> was launched in Croatia in June 2013 at a total value of 7 million euros, out of which 60% is financed from national sources. Project duration is from 2013 until 2017 and 83 fellowships are available;
- Programme “[Preparation of the research infrastructure projects pipeline](#)”<sup>24</sup> aimed at supporting the preparation of technical documentation for infrastructural projects in the field of research, development and innovation within the OP Regional Competitiveness; those projects should be prepared for funding from the European Regional Development Fund in the framework of the Operational Programme for Competitiveness and Cohesion in the programming period of 2014-2020; the current Indicative list of projects consists of 99 project proposals, of which 22 in science and 77 in education.
- Programme “[Partnership in research](#)”<sup>25</sup> coordinated by the CSF was re-launched in December 2014 with the aim to establish research cooperation between PROs/HEIs and partners with the research funds outside the State budget; the total State budget amounts to €1.9m for 2-3 year projects;
- The RAZUM programme <sup>26</sup> (Development of knowledge-based companies) coordinated by the HAMAG-BICRO has been re-launched in February 2015 with the aim to fund R&D activities in SMEs that will result in innovative product or service ready for market. A total fund of €2.9m has been provided by the [Second Science and Technology Project](#) (STP II). Financial aid will be granted in the form of a conditional loan for a maximum of 70% of the costs, while the remaining 30% is financed from own resources. The largest amount of an individual project is €1.2m while the project duration is limited to a maximum of 24 months.
- The [IRCRO programme](#)<sup>27</sup> coordinated by HAMAG- BICRO has been re-launched in February 2015 with the aim to fund the development of new products, services or processes undertaken by individual entrepreneurs or SMEs and involve cooperation between research institutions and private sector. A total fund for the programme of €1.8m has been provided by the [Second Science and Technology Project](#) (STP II). Projects grants are aimed to co-finance 50% of eligible project costs. The maximum amount for co-financing of the project is €0.2m. Project duration is limited to a maximum of 24 months;
- TTO support programme coordinated by HAMAG-BICRO (as a part of STP II) has been launched in February 2015 with a goal to strengthen the role of technology transfer offices at PROs and HEIs as the central places for fostering and implementing technology transfer. The specific objective of the TTO Support programme is to foster commercialization of the exiting project pipeline of TTOs acting at PROs and HEIs. The overall indicative amount available under TTO Program is €1.5m. The programme funds 100% of the total eligible costs. The funding grants range between €10,000 and €75,000 per project. Project duration is 18 months.

<sup>23</sup> <http://www.newfelpro.hr/default.aspx?id=63>

<sup>24</sup> <http://public.mzos.hr/Default.aspx?art=12983&sec=3423>

<sup>25</sup> <http://www.hrzz.hr/default.aspx?id=2209>

<sup>26</sup> <http://www.hamagbicro.hr/inovacije/privatni-sektor/razum/>

<sup>27</sup> <http://www.hamagbicro.hr/inovacije/privatni-sektor/ircro/javni-poziv/>



The [Second Science and Technology Project](#) (STP II) a joint project of the MSES and the World Bank to modernise the Croatian research system was launched in April 2013, after successfully completing [STP I](#) in May 2011. With a loan of €20m from the International Bank for Reconstruction and Development (IBRD) the project will bridge the existing gap in financing of research and development to full availability of EU Structural Fund. The main aim of the project is to improve the capacity of Croatia's R&D and innovation institutions for absorption of the EU Structural and Cohesion funds. The STP began on July 31, 2013 and will last until July 30, 2017.

In the framework of the Regional Competitiveness Operational Programme 2007-2013, the "Biosciences Technology Commercialisation and Incubation Centre - BIOCentre" project is being implemented to provide relationship between basic and applied scientific research and technological infrastructure for new biotechnology companies. In addition, a grant contract worth of €23m has been signed for the construction/reconstruction of scientific research infrastructure of public scientific organisations - "The Development of the Research Infrastructure at the University of Rijeka Campus". Furthermore, in December 2013 the restricted call for proposals "Preparation of infrastructure project pipeline for ERDF 2014-2020" was launched. These measures represent first steps in fulfilling the goals of the "Research Infrastructure Roadmap 2014-2020".

### **2.3 National Reform Programmes 2013 and 2014**

In the framework of economic and fiscal supervision, EU member states are obliged to develop documents allowing multilateral monitoring and coordination of their economic policies. In that context, during the pre-accession period (2005-2012), the Republic of Croatia has worked on the development of the Pre-accession Economic Program (PEP). On the eve of its accession to the EU, in 2013 Croatia elaborated on the transitional document [Economic Programme of Croatia](#)<sup>28</sup>, as part of its informal participation in the European Semester 2013.

Currently, as a full member of the European Union, Croatia adopted the first [National reform programme](#) (NRP)<sup>29</sup> on April 24 2014, as part of a yearly cycle of economic policy coordination on the European level called the European Semester .It currently represents the relevant document based on which national goals and achievements related to the Europe 2020 objectives can be assessed.

National Reform Programme grouped reform measures in four key areas (public finance, financial sector, labour market and competitiveness) and analyses the progress made towards achieving the five major objectives of the EU 2020. The national values of the Europe 2020 headline targets defined by the 2013 Economic Programme have been revised by the this National Reform Programme in order to become more ambitious in terms of increased values of employment target and reduction of poverty. The employment rate of the population aged 20 – 64 was increased from 59% to 62.9%, a rate that Croatia had before the crisis. An expected reduction of persons threatened by poverty and social exclusion is estimated by 150,000 or from 1.370.000 in 2012 to 1.220.000 because Croatia it is one the most vulnerable member state in this aspect.

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<sup>28</sup> [http://ec.europa.eu/europe2020/pdf/nd/ep2013\\_croatia\\_en.pdf](http://ec.europa.eu/europe2020/pdf/nd/ep2013_croatia_en.pdf) (last accessed: 15 February, 2015)

<sup>29</sup> [http://ec.europa.eu/europe2020/pdf/csr2014/nrp2014\\_croatia\\_en.pdf](http://ec.europa.eu/europe2020/pdf/csr2014/nrp2014_croatia_en.pdf) (last accessed: 15 February, 2015)

Goals with R&I relevance primarily refer to raising investment in research and development. The main objective of measures envisaged in this area is the increase in the share of total domestic expenses for research and development to 1.4% of GDP by 2020 compared to 0.75% of GDP in 2012. This level is still below the EU average and after Cyprus, Greece, Romania, Bulgaria and Latvia the sixth lowest value targets in the EU which does not allow the transition to a knowledge-based economy. In 2014 annual investments in R&D are expected to increase to 0.85% of GDP, based on a forecasted growth rate of investments of 8%.

Nevertheless, as a full EU member, Croatia has a chance to increase its level of investment into R&D by the means of EU Structural Funds. [The National Strategic Reference Framework](#)<sup>30</sup> (NSRF) was approved by the European Commission in August 2013 and it defines the strategy for the use of resources from the Cohesion and structural funds. Moreover, the [Partnership agreement](#)<sup>31</sup> (PA, 2014) that has been officially submitted by Croatia to the European Commission in April of 2014 strongly supports growing investments into research and innovations. Its statement that “transforming existing knowledge into productivity gains and innovation can be considered as a major potential for future economic growth in Croatia” is fully supported by the NRP. In this regard, R&D in the business sector shall be especially supported, as well as scientific excellence in the areas of smart specialisation and cooperation between academic and business sectors.

In the context of strengthening the national R&I system and the innovation potential of the economy, the NRP acknowledged and welcome recently drafted strategic documents: the [Strategy for innovation encouragement of the Republic of Croatia 2014-2020](#)<sup>32</sup>, the Smart Specialisation Strategy, the [Strategy for Education, Science and Technology](#)<sup>33</sup> and the [Research Infrastructures Roadmap 2014-2020](#).<sup>34</sup> These documents will ensure a broad policy framework for the usage of the European structural funds since Croatia plans to invest substantial resources from the European Structural and Investment funds (ESI) in the period of 2014 to 2020 in research and innovation, with the aim to ensure long-term sustainable growth.

According to NRP appropriate measures have been taken in 2013 and 2014 in order to improve the quality, management and funding systems of scientific organisations and encourage scientific excellence. Among many listed actions the following can be sorted out to illustrate improvement in management and coordination of R&I system: /1/ establishment of the Scientific centres of excellence in 2013, /2/ Decision on multi-annual institutional funding of research activities in PROs and HEIs based on performing indicators, /3/ strengthens the role of the National Council for Science, Higher Education and Technological Development as the highest authority for R&D, /4/ initiating the process of re-accrediting public scientific institutes and a thematic evaluation of postgraduate

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<sup>30</sup> [http://www.strukturnifondovi.hr/UserDocImages/Documents/Strukturni%20fondovi%202007.%20-%202013/nsrf\\_en.pdf](http://www.strukturnifondovi.hr/UserDocImages/Documents/Strukturni%20fondovi%202007.%20-%202013/nsrf_en.pdf) (last accessed: 15 February, 2015)

<sup>31</sup> [http://www.mrrfeu.hr/UserDocImages/EU%20fondovi/PA\\_OFFICIAL%20PROPOSAL\\_CROATIA.pdf](http://www.mrrfeu.hr/UserDocImages/EU%20fondovi/PA_OFFICIAL%20PROPOSAL_CROATIA.pdf) (last accessed: 14 February, 2015)

<sup>32</sup> [http://www.mingo.hr/public/documents/Strategija\\_poticanja\\_inovacija\\_18\\_12\\_14.pdf](http://www.mingo.hr/public/documents/Strategija_poticanja_inovacija_18_12_14.pdf) (last accessed: 14 February, 2015)

<sup>33</sup> <https://vlada.gov.hr/UserDocImages/ZPPI/Strategije/Strategija%20obrazovanja.%20znanosti%20i%20tehnologije%20%28radni%20materijal%29.pdf> (last accessed: 14 February, 2015)

<sup>34</sup> <http://public.mzos.hr/fgs.axd?id=2180> (last accessed: 15 February, 2015)

doctoral studies, /5/ comprehensive audit of the system of state incentives for research, development and innovations.

All these measures and actions will serve for the improvement of the national innovation management system, strengthening the cooperation between science and the business sector, the economy innovation potential and human innovation resources.

In addition, project documentation for the national Science and Technology Foresight Project (STF) was drafted during 2014. STF involves systemic analysis of the long-term trends in science and technology in order to create and implement tools and methods for development and sustainable execution of evidence based policy in the area of RDI, specifically for development and monitoring of smart specialization strategy and other strategic documents, as well as to competitiveness, economic development and society. One of the most relevant project outcomes will be an integrated data base – the National Information System in Science (NISS).

## ***2.4 Policy developments related to Council Country Specific Recommendations***

n/a

## ***2.5 Funding trends***

### ***2.5.1 Funding flows***

In the period of strong development of Croatian economy, national development goal was to reach R&D expenditures level of 3% of GDP by 2010, with annual increase of at least 25%. GERD reached its maximum in 2004, when it amounted to 1.05% of GDP, after which it declined to 0.87% in 2005 and 0.75 in 2006. Slight increase was then recorded in 2007, when GERD reached 0.8% of GDP and in 2008 (0.9%). However, under the influence of economic downturn caused by global financial crisis, recession and structural gaps of Croatian economy, GERD declined again in 2009, reaching 0.85% of GDP, and in 2010 (0.75%), after which it reached 0.76% in 2011 and 0.75% of GDP again in 2012. With the adoption of the Economic Programme of Croatia in April 2013, new goal has been set to reaching R&D expenditures in the amount of 1.4% of GDP by 2020. Slight increase has been recorded in 2013, when GERD reached 0.81% of GDP.

From the current situation point of view, achieving of this, significantly lowered goal for R&D expenditures, still presents a challenging task. Expenditures on R&D have been constantly decreasing since GERD reached 1.05% in 2004 (with the exception of 2008 - 0.9% of GDP), revealing structural gaps of the overall R&D system, as well as of the economy in general.

In the period 2010-2012, GERD remained at mostly constant level of 0.75-0.76% of GDP, with slight increase in 2013, reaching 0.81% of GDP, which still presents decrease as compared to levels achieved in years before (0.85% in 2009).

Share of government budget appropriations or outlays on R&D (GBAORD) in total general government expenditures in Croatia amounted to 1.59% in 2012, and remained at the same level in 2013. This is somewhat higher than in the preceding years (1.51% in 2009;

1.57 in 2011) and higher than the EU-28 average of 1.41% in 2013. Total GBAORD amounted to €334m in 2011 (0.76% of GDP) and decreased to €318.465m in 2012, reaching 0.73% of GDP. Additional decrease was reported for 2013, when GBAORD reached €268.714.

The business sector funded only 42.8% of GERD in 2013, which presents an increase from 2012, when business sector R&D funding reached 38.2%, and above the level of 40.8%, reached in 2008, before the economic crisis. The government sector funded 39.7% of GERD in 2012, while HEIs contributed with 1.7%. Compared to the years before, significantly higher share of R&D was funded from abroad (15.5% in 2013 and 14.4% in 2012). HEIs and government sector performed around 54% of GERD in 2012 and 49.9% in 2013, while business enterprise sector performed around 46% of GERD in 2012 and 50.1% in 2013. Although the public sector still performs a significant share of R&D, recent trends reveal a substantial increase of business sector performance in GERD. For comparison, in the EU-27 public sector performed around 36% of GERD and funded around 34% of GERD in 2011.

The Government finances around 76% of research activities at HEIs (75.8% in 2012) and 84% at public institutes. On the other hand, in 2012 the Government financed only 1.2% of R&D in the business sector and the majority of R&D expenditures (65.6%) in the business sector were financed by the companies themselves, followed by 23.5% of resources that came from foreign investors. Although the share of government funding of R&D still remains quite high, it shows decreasing trends over the last years. In 2008, the government financed 81.2% of R&D at HEIs, 84.3% at public institutes and 1.8% in the business sector. In the same period, the share of foreign resources for R&D has almost doubled, from 7.9% in 2008 to 14.4% in 2012. However, the government still finances almost 44% of all research activities in Croatia.

The availability of budget resources for many research and innovation programmes still remains uncertain due to the constant budget cuts and negative economic situation in the country. Comprehensive changes in R&D funding mechanisms have been adopted (primarily the new Act on Science and Higher Education and changes in the institutional setup) and are expected to bring more efficient allocation of budget resources. There are also high expectations from EU Structural and Cohesion Funds, which have become available to Croatia upon the EU accession in July 2013.

Over the last years, funding from abroad gained an increasing share in overall R&D funding in Croatia, which participated in Framework Programmes since 1998, as a “third country”. According to the MSES (2013) data, in the period 1998-2006, 154 Croatian partners have participated in 134 projects co-funded with € 15.1 million from FP5 and FP6. In the period January 2007 – June 2013, 309 Croatian partners participated in 248 projects, which were co-funded from FP7 with €70.5 million.

**Table 1. Basic indicators for R&D investments**

	2009	2010	2011	2012	2013	EU28 (2013)
GDP growth rate	-6.9	-2.3	-0.2	-2.2	-0.9	0.1
GERD (% of GDP)	0.85	0.75	0.76	0.75	0.81	2.02
GERD (euro per capita)	85.8	75.7	76.2	77.2	83.2	539.2
GBAORD - Total R&D appropriations (€ million)	312.446	324.603	334.206	318.465	268.714	92,094.205
R&D funded by Business Enterprise Sector (% of GDP)	0.34	0.29	0.29	0.29	0.35	1.1% (2012)
R&D funded by Private non-profit	0	0	0	0	0	0.03% (2012)
R&D funded from abroad	0.06	0.07	0.09	0.11	0.13	0.2% (2012)
R&D funded by Framework Programmes	N/A	N/A	N/A	N/A	N/A	N/A
R&D funded by the Structural funds	N/A	N/A	N/A	N/A	N/A	N/A
R&D related FDI	N/A	N/A	N/A	N/A	N/A	N/A
R&D performed by HEIs (% of GERD)	32.31	28.23	27.76	26.53	24.69	23.19% )
R&D performed by Government Sector (% of GERD)	27.16	27.53	27.38	27.48	25.53	12.21%
R&D performed by Business Enterprise Sector (% of GERD)	40.42	44.10	44.71	45.85	50.10	63.75%
Share of competitive vs. institutional public funding for R&D	N/A	N/A	N/A	N/A	N/A	N/A
Employment in high- and medium-high-technology manufacturing sectors as share of total employment	3.4	3.3	3.7	3.9	3.5	5.6%
Employment in knowledge-intensive service sectors as share of total employment	29.4	30.3	30.1	31.3	33.2	39.2%
Turnover from Innovation as % of total turnover	N/A	10.5	N/A	N/A	N/A	13.4% (EU-27, 2010)

### 2.5.2 Project vs. institutional allocation of public funding

Traditionally, project based funding has rather low share in total GBAORD, while institutional funding covered over 90% of public funding for R&D. However, reforms of the science sector, which have recently been implemented, should significantly improve the ratio between project and institutional funding of R&D in Croatia. Most important changes include the introduction of institutional funding on a three-year basis (compared to annual decisions made in the past), as well as a transfer of responsibilities for project-based

allocation of public funding from the Ministry of Science, Education and Sports to the Croatian Science Foundation.

Amendments to the Act on Science and Higher Education, adopted in 2013, introduced significant changes to the overall Croatian R&D system. A new model for public R&D funding has been developed, focused on awarding multi-annual block grants for HEIs and PROs from the State budget by MSES. Funding is now awarded at a three-year basis, with funding amounts determined on the basis of institutional performance indicators. For the period 2013-2015, indicators have been evaluated during the first half of 2013, after which the exact funding amounts have been agreed between MSES and HEI/PROs. Decision on multi-annual institutional funding of research activities in public research institutes and universities for the period 2013-2015 has been adopted in June 2013.

The process of awarding competition-based R&D grants has also experienced significant changes. The “old” system, in place since 1991, was primarily based on allocation of competition-based project grants from the State budget through the Z-project programme, administered by the MSES. Since 2013, responsibility for R&D grants allocation has been transferred from MSES to the Croatian Science Foundation. New procedures include more rigid project evaluation process aimed at selection of fewer high quality research projects (around 20%). Compared to the new system, allocation of funds through the Z-projects programme included a large number of smaller R&D projects, with very high rate of approval (around 80%). For the period 2013-2014, funding of around 200 projects has been planned within the CSF’s [Action plan for announcing public call for proposals for research projects from July 2013 to July 2014](#). This is significantly lower number of projects that previously selected through the Z-projects programme (around 2,500). Through these institutional changes, Croatian Science Foundation became a principal agency for allocation of project-based public funding of R&D activities in Croatia.

Another new form of institutional funding has also been introduced in 2014. This refers to the Centres of Research Excellence, whose establishment will be funded by MSES from the State Budget. For the period 2014-2016, €0.330m annually has been reserved within the State Budget, which should be sufficient for the initial phase of establishing 7 centres. Additional financial resources for Centres are planned to be ensured from the EU Structural Funds.

Unity through Knowledge Fund (UKF) was merged with CSF in February 2014. UKF was established in 2007 by the Ministry of Science, Education and Sports supported by the World bank loan within the Science and technology project. It supported collaborative research with Croatian scientists living in Croatia and abroad and leading international scientific institutions to raise absorption capacity for EU funds, especially Structural and Horizon 2020. It was considered a highly successful Fund which established, for example, collaboration with 133 foreign research institutions including Mack-Planck Institute, Swiss Federal Institute of Technology, and Johns Hopkins University; etc. The projects financed within the Fund realized great success among the applications for call for proposals in the FP7 program for research and technological development – success rate thereof is in the 35% range. The Fund invested €3.6 million in the acceptance of projects, and an additional €9.03 million was extracted from the FP7 program, entitled to Croatian partners. In addition to the financing, success of the Fund’s projects within FP7 provided Croatian research groups with international recognition, visibility and competitiveness in a worldwide scope.

Since the reforms of the Croatian science system have been implemented only recently, their effect on the ration between institutional and project funding remain to be seen in the future.

Before these changes have been introduced, research activities were mainly financed from the State budget resources, allocated by the MSES. This type of funding made about 80% to 85% of total research funding at public research institutes and universities. When it comes to type of expenditures funded by the MSES, about 70% were salaries, 10% direct institutional funding (overheads, phone, energy, etc.), 10% research grants (material and operational costs) and remaining 10% other research-supporting activities (conferences, publishing, etc.)

The share of project based funding in GBAORD was rather low until 2013, and amounted to 6.2% in 2011 and 5.6% in 2012, while institutional funding amounted to 93.8% and 94.4%, respectively. The implemented reforms should significantly increase the share of project-based funding in total public funding of R&D activities in Croatia, which already increased to 8.5% in 2013.

As already mentioned, institutional funding is based on institutional assessment since 2013. The amount depends on the institutional performance indicators of scientific activity in the previous five-year period. They include four types of criteria with different values of weights depending on their importance for research evaluation, as follows:

- Scientific productivity (with the largest weight of 60%) which includes the number of scientific papers published in journals covered by the Web of Science and SCOPUS, number of citations and the number of employees who attained doctoral degree in a given period. The number and type of publications are further specified by the 6 scientific areas of natural, technical, biotechnical, biomedical, social sciences and humanities;
- National and international competitive research projects and mobility (25% of weight) includes the number of national competitive research projects (CSF and UKF) and the number of projects funded by foreign resources (FP6 , FP7, ESF, HERA, COST );
- Popularization of science (5% of weight) includes participations in actions like Festival of Science;
- Commercialisation of science (5 % of weight) includes the number of contracted projects with businesses, government bodies and local authorities, civil sector and non-governmental organizations.

The allocation of total funds of € 6.6m per year to each institution depends on the institutional coefficient, calculated by a complex formula which includes given criteria and a number of other elements combined with the specific coefficients and ratios such as: an average and basic value of scientific area, the coefficient for a particular area of science (natural sciences = 2.7; engineering = 2.5; biomedical Sciences =2.7; biotechnology = 2.6; social sciences = 1.2; humanities and arts = 1.2), number of researchers in full-time equivalent (FTE) by a field of science, etc.

Each institution is obliged to deliver the annual report about its scientific activities in standardized format to provide the required criteria needed to calculate the institutional coefficient.

Based on the received programme resources, the universities have established the Fund for the development of universities and carried out a public call at the universities' level for research projects to allocate the given resources. Systemic and integrated data on granted funds are presently missing.

Croatian Science Foundation currently implements three programmes:

- **Installation research projects**

The programme enables scientists to establish their own laboratory and/or a research group during a 3-year period of funding. At the same time, the institution must support the work of the emerging research group, and demonstrate its support to the young researcher's group even after the completion of the funding period ensuring the transfer of specialized knowledge and the successful development of professionals in the internationally competitive issues.

- **Research Projects Programme**

Programme supports research groups that are working on internationally/ nationally competitive issues, and whose leaders have been recognized for their scientific achievements and mentoring skills. Main goal is to create a critical mass of research groups that will be competitive at the international level.

- **Young Researchers' Career Development Project – Training of Doctoral Students**

Main aims of the programme are to enable scientifically active mentors who are engaged in internationally and/or nationally significant issues to involve in their research projects young researchers who wish to participate in scientific research and focus their career towards cutting-edge science. The ultimate goal is the training of new doctoral students who will continue their career in competitive research and/or development of new technologies in the economy.

The evaluation process of applications for funding from Installation research projects and Research Projects programmes consists of four main evaluation stages. After an administrative check, proposals are evaluated by evaluation panels, consisting of Croatian experts. In this round, the evaluation process is focused on experience and achievement of the project manager, relevance and innovativeness of the proposal, clarity and argumentation of project goals, hypothesis and work plan, proposed research methodology and feasibility of the research plan. Successful project proposals are then subject to a peer review process, conducted by international and, in the case of projects in the area of humanities, domestic experts. Peer review is primarily focused on importance of the research, quality and innovativeness of proposed research plan, publication potential and feasibility evaluation of the project proposal. After the project has satisfied the peer review, evaluation panels further evaluate financial plans, existence of any ethical doubts and support of the institution.

Since Croatian accession to the EU, several new programmes funded from EU funds have been initiated (please see Section 2.2). The programme "Strengthening capacities for research, development and innovation was launched in January 2014 with a focus on applied and industrial research which should be realized in cooperation between research institutions (applicant) and industrial/business partner in order to achieve results with potential commercial applications or creation of the new relevant knowledge. The total indicative budget of the Call is €9.3m out of which the contribution of the ERDF amounts



to €7.9m and national contribution amounts to €1.4m. In this call the maximum grant amounts to around €1m and the minimum grant amounts €0.2m.

Currently, there are no additional funding programmes which cannot be classified as either project or institutional funding. Besides institutional funding resources allocated by MSES, most of R&D funding programmes allocate financial resources on a project basis.

Most of the implemented structural reforms of the Croatian research and innovation system should influence positively on the balance between project and institutional funding, primarily through increasing the share of project funding and award of funding based on clear and relevant criteria. However, the programmes previously administered by HAMAG-BICRO (previously BICRO) were ex-post evaluated in 2013. These programmes have had significant impact on development of research and innovation infrastructure in Croatia, as well as on development of research projects and innovation activities of both research organisations and SMEs.

### **2.5.3 R&I funding**

Over the last years, programmes aimed at innovation funding have primarily been administered by BICRO. When these were implemented, they covered a whole range of R&I activities, from research to commercialisation. Since these programmes (public calls) are currently closed, funding of commercialisation activities of both research organisations and SMEs are not covered by public funding from the State budget. In 2014, significantly higher share of resources has been ensured for CSF programmes (€13m) than for the BICRO programmes (€5.2m). In addition, the World Bank loan, under the Science and Technology Project II, was launched in 2013, but new public calls in 2014 have not been published.

In 2014, the Croatian Agency for SMEs and Investments and Business Innovation Agency of Croatia (BICRO) have been merged into a new agency – Croatian Agency for SMEs, innovation and investments (HAMAG-BICRO). The main goal of this merger was the creation of a unique system for supporting entrepreneurs through all development phases – from research and development to commercialisation and market entrance. Previously, BICRO implemented several measures through which funding of innovative SMEs has been provided, with the support by the World Bank loan (Science and Technology Project). The programmes (PoC, RAZUM and IRCRO) will be implemented through the STP II until the end of the programmes in June 20. However, the future of these programmes after the end of the STP II is uncertain since it seems that there is no plan to continue their financing through the Structural funds.

Ministry of Entrepreneurship and Crafts (MEC) also manages several programmes aimed at innovation development, under the comprehensive Entrepreneurship Impulse Programme, oriented towards development of SMEs in Croatia. Through the MEC Impulse programme, total of €1.5m has been ensured for measure “Innovations in entrepreneurship”, aimed at development and introduction of innovations in SMEs’ businesses, while additional €8.5m has been allocated to the measure “Small and Medium Entrepreneurship and Crafts”, mostly for co-funding of development and purchase of the new technologies and development research activities. In the past, most of the public funding resources have been aimed at R&D activities.

Programmes administered by BICRO were designed in order to foster cooperation between science and industry. While in some cases SMEs could apply for funding only through public

organisations acting as “recognised centres”, in other cases eligibility criteria included involvement of both public research organisation and SME involvement in development of innovative project.

Croatia has a relatively generous system of tax breaks for R&D, as compared to OECD countries, which corresponds to a subsidy of about 35% for US\$1 of R&D, which is right behind France (42% in 2008). An analysis conducted in 2011 (Aralica et al., 2011) revealed that tax incentives are a more generous form of state aid for R&D than subsidies. 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. For example, in 2009 subsidies amounted to less than a third of aid granted by the tax incentives. Although over 270 companies used tax incentives, 90% of the total tax incentives have been realized by a small number of companies: 9 in 2008 and 27 in 2009. This indicates that a few companies conduct large research projects and the concentration of tax incentives into a small number of users is present. It is estimated that the “tax breaks tend to be irrelevant to SMEs and to favour incumbent firms to the detriment of entrants” (World Bank, 2012). However, tax incentives prove to be of large assistance to companies and have the effects of additionality (increase the investment of companies in R&D). It is estimated that each forgone HRK generates 1.19 HRK of R&D investments but a significant number of potential beneficiaries do not use it due to concerns about excessive red tape. Form and amounts of tax incentives for R&D have not changed significantly over the last three years.

Other forms of innovation funding in Croatia (such as public-private partnership, venture and seed capital, etc.), are still highly underdeveloped in Croatia, and do not influence the access to finance for innovative companies.

BICRO (now HAMAG-BICRO) developed several support measures in 2007, aiming at providing funding to innovative SMEs, supported through the World Bank loan (Science and Technology Project), including Development of Knowledge-Based Companies Programme – RAZUM and Venture Capital Programme – VENCRO, an public-private partnership initiative to encourage potential fund managers to start venture capital funds in Croatia. However, difficulties in finding an appropriate private partner prevented the actual implementation of the measure. RAZUM programme provides financing to start SMEs for projects at a pre-commercial development phase. In the period 2007-2012, 24 projects have been approved for funding from the RAZUM programme, with contracted funding of € 15 million.

The Proof of Concept (PoC) Programme, also administered by BICRO, is the newest policy measure introduced in 2010. The programme was created to ensure pre-commercial capital for technical and commercial testing of innovation concepts. So far, PoC has achieved significant results in terms of the number of applications and the quality of applied projects. Its evaluation procedures are transparent and effective, which is one of the reasons for the continuous increase in the number of applications.

Currently, there are also two credit guarantee schemes administered by HAMAG-BICRO which provide credit guarantees for innovation activities. In the case of the “EU Beginner” programme, guarantee cannot exceed 80% of the credit amount, while in the case of the “Let’s grow together” programme, the guarantee cannot exceed 70% of the credit amount.

In addition, the ESI funds will significantly contribute to funding of R&I. The total funds for the Priority axis one „Strengthening the Economy through Application of Research and Innovation” of the Operational Programme Competitiveness and Cohesion 2014–2020 (OPCC, 2014) amount to €664.7m.

## **2.6 Smart Specialisation (RIS3)**

The Smart Specialisation Strategy (S3) is of great importance for development of R&I activities in the forthcoming period since all investments from the EU Structural and Cohesion funds should be clearly linked to the competitive strengths and comparative advantages identified by the Smart Specialisation Strategy. S3 should unify all the relevant aspects from the various national strategies in a strategic framework that has a long term perspective (2025).

The preparation of the S3 is coordinated by the Ministry of economy (MoE) supported by the EU co-funded team of experts (S3-Expert team) who assisted in drafting the analytical part of the Strategy in the period September 2013-March 2014. Besides, MoE has established the Inter-ministerial Working and Steering Group which included MSES, MOC, MRDEUF, MLPS and other relevant ministries. It conducted partnership consultations to provide inputs and feedback to ideas for strategic directions of S3. In the process of preparation, private and public research sectors were continuously consulted, and five regional workshops (Partnership Consultations) were held.

A number of analytical input documents have been produced as a starting point for the S3 such as Business expenditure on R&D, Cross-Sector competitive advantage analysis, Technology usage and availability including KETs, Research and development, KET deployment in Croatia by the PRODCOM identification methodology, etc. A final Draft version of S3 was produced and will be presented to European Commission.

It turned out that identification of economic areas, industries and key enabling technologies of strong comparative advantages presented a challenging task especially in Croatia characterised by much diversified economic structure, scattered research capacities and a lack of analytical data.

On the basis of the identified global trends, strengths and potentials in the business and R&D sector of Croatia and according to the results of the entrepreneurial discovery process and the main S3 selection criteria's, the following five priority areas with relevant technological and production fields have been selected as the main focus for the S3 in Croatia (Skočilić, 2025):

- health and quality of life,
- energy and sustainable environment,
- transport and mobility,
- security and
- agro-food and bio-economy.

Within these five priority areas, sub-areas will be defined. Croatia's research capacities coincide with the industry's competitiveness in areas of telecommunications, electrical equipment, food processing, pharmaceuticals, engineering (machinery) and ICT.

The Strategy also recognized several important cross cutting themes such as ICT, tourism, creative and cultural industries and green growth KETs where Croatia clearly have has comparative advantages.

Delivery instruments have been created in line with SWOT analysis that emphasized several key weaknesses in R&D system in Croatia e.g. declining share of students in STEM fields, mismatch between educational system and business needs, unfavourable skill profile in the business sector for RDI, low mobility of researchers and low shares of researchers in business sector, insufficient market driven research, lack of R&D collaboration between science and research institutions and business sector, scattered research resources with insufficient capacities to conduct excellent science, fragmented and inefficient national innovation system and lack of linkages in innovation value chain, insufficient commercialization of research results and insufficient research orientation towards the needs of the economy, insufficient investment in R&D in business sector and limited patenting and commercialization culture.

In order to tackle these challenges, Strategy will include ESI funds allocation channelled by MSES, MoE and MoEC. The Strategy will also include list of indicators for monitoring and evaluation in line with the governance structure. It is expected that the document will be adopted by the Government until the end of June 2015.

## ***2.7 Evaluations, consultations, foresight exercises***

The evaluation system of R&I policy mostly consist of two components. The first refers to the relatively well developed institutional quality assurances system of PROs and HEIs while the second relates to the still weak system of evaluation R&I policies and supporting programmes. There is a third component of evaluation research activities at HEIs and PROs introduced in 2013 to satisfy a new type of research funding focused on performance based institutional funding based on a complex set of predefined criteria.

In the area of institutional assessment Croatia is at the forefront in the application of the European standards and guidelines since they were introduced in Croatia in 2009 by the adoption of the Law on Quality Assurance in Science and Higher Education (Official Gazette No. 45/2009). Based on the Law, the Agency for Science and Higher Education (ASHE) is established as an independent pillar institution of quality assurance which is modelled after the best European practices and proved its reliability as a quality assurance agency. Based on the [Quality Assurance Manual](https://www.azvo.hr/images/stories/kvaliteta/Quality_Assurance_Manual.pdf)<sup>35</sup> from October 2010, the responsibilities of ASHE regarding research and higher education system include: initial accreditation, re-accreditation, thematic evaluation and external audit of PROs and HEIs.

The first evaluation procedures of PROs were carried out by the ASHE in the period 2007-2009 in line with the Act and the [Ordinance on Evaluation of Scientific Organizations](https://www.azvo.hr/images/stories/vrednovanja/vrednovanja_znanost/Pravilnik_o_vrednovanju_znan_organ_ENG.doc)<sup>36</sup> (Official Gazette 39/05). The process of re-accreditation of 25 public research organizations was launched in early 2013 and concluded by mid-2014. The evaluation is based on the procedure of external evaluations determined by the [Principles and Criteria for the Evaluation of Scientific organisation](https://www.azvo.hr/images/stories/vrednovanja/vrednovanja_znanost/Nacela%20i%20kriteriji%20vrednovanja%20Z0%20u%20RH_ENG.pdf)<sup>37</sup> adopted by ASHE in February 2013. The

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<sup>35</sup> [https://www.azvo.hr/images/stories/kvaliteta/Quality\\_Assurance\\_Manual.pdf](https://www.azvo.hr/images/stories/kvaliteta/Quality_Assurance_Manual.pdf) (last accessed: 16 February, 2015)

<sup>36</sup> [https://www.azvo.hr/images/stories/vrednovanja/vrednovanja\\_znanost/Pravilnik\\_o\\_vrednovanju\\_znan\\_organ\\_ENG.doc](https://www.azvo.hr/images/stories/vrednovanja/vrednovanja_znanost/Pravilnik_o_vrednovanju_znan_organ_ENG.doc) (last accessed: 16 February, 2015)

<sup>37</sup> [https://www.azvo.hr/images/stories/vrednovanja/vrednovanja\\_znanost/Nacela%20i%20kriteriji%20vrednovanja%20Z0%20u%20RH\\_ENG.pdf](https://www.azvo.hr/images/stories/vrednovanja/vrednovanja_znanost/Nacela%20i%20kriteriji%20vrednovanja%20Z0%20u%20RH_ENG.pdf) (last accessed: 16 February, 2015)

external evaluation is carried out by the expert panel whose members are composed of distinguished scholars and professors from British, German, North American, Scandinavian, Austrian and other universities and scientific institutes.

External evaluations are based on self-evaluation which scientific organizations had to draft on the predefined form, as well as site visit and interviews with representatives of scientific organization. Re-accreditation process could produce three types of recommendations: /1/ for license extension or /2/ denial, or /3/ issues letters of expectation which require actions for improving the research activities.

Pursuant to the Decision on multi-annual institutional funding of research activities in public research institutes and universities 2013-2015, and planned funds in the state budget, multi-annual agreements on the financing of scientific activity were agreed with all public universities and public scientific institutes. An amount of €19.8m to fund exclusively the multi-annual research programmes was provided for this purpose for a three-year period. The amount of provided funds for a specific institution is determined based on the [performance –based indicators](#)<sup>38</sup> related to the Decision on multi-annual institutional funding. The process involves a rather complex calculation which takes into account specificities of the scientific disciplines and selected 4 criteria stipulated by the MSES: /1/ scientific productivity - weight 60%, /2/ national and international competitive research projects and mobility of researchers - weight 25%, /3/ popularization of science - weight 5%, /4/ science cooperation with businesses, government authorities, civil sector and NGOs - weighting 10. This funding system introduced in 2013 will ensure higher autonomy and responsibility of universities and research institutes in management and deciding on investments in research activities.

Apart from evaluation procedures for research activities, all public and private higher education institutions financed from the national budget have to undergo a periodical re-accreditation every 5 years. The initial accreditation was initiated by the Bologna process in 2006. The first re-accreditation cycle started in the 2010/2011 academic year and it should end in the 2015/2016 academic year. By the end of 2013, HEIs delivering study programmes in the fields of economics, technical and biotechnical sciences, and majority of private higher education institutions underwent re-accreditation. Re-accreditation of HEIs offering study programmes in social sciences and humanities is underway.

The Government of Croatia adopted the Programme for establishing [centres of research excellence](#)<sup>39</sup> (CoRE)) in June 2013 with the aim to identify research groups of international relevance with the potential in frontier research and cutting-edge science. The evaluation process of the potential centres is based on the “[Process of evaluation of scientific quality in order to establish scientific centres of excellence in Croatia](#)<sup>40</sup>” adopted by the ASHE which involves the following criteria: scientific excellence of the project (weight 35%), scientific excellence of principal scientist and researchers (weight 35%); interdisciplinarity and networking (weight 5%), potential for international competitiveness (weight 5%), organizational structure (weight 5%), socio-economic contribution and knowledge transfer (weight 5%), accommodation conditions at the host institution (weight 10%).

The second component, the evaluation of research and innovation policies or programmes is rather weak. Periodic or interim evaluations of research projects and programmes have

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<sup>38</sup> <http://public.mzos.hr/Default.aspx?sec=3521>(last accessed: 16 February, 2015)

<sup>39</sup> <http://www.zci.hr/> (last accessed:16 February, 2015)

<sup>40</sup> [http://www.erf.unizg.hr/stari\\_web/Dokumenti/PostupakZCI-AZVO.pdf](http://www.erf.unizg.hr/stari_web/Dokumenti/PostupakZCI-AZVO.pdf) (last accessed: 16 February, 2015)

been carried out mostly for administrative purposes of funding institutions. However, the three ex-post evaluation studies of innovation programmes have been carried out up to now.

The first two ex-post evaluation studies of the innovation supporting programmes were carried out in 2011 and 2012. One study evaluated the [Science and Technology Project](#)<sup>41</sup> (STP), a joint project of the MSES and World Bank to modernize the Croatian research system was carried out in February 2012 (World Bank, 2012). The study concluded that the programme helped Croatia establish and develop the institutions and programmes inherent to modern R&D and innovation systems. It also helped R&D institutions to commercialize research outputs on the one hand and increased the ability of enterprises to develop, use and adapt technologies on the other hand. Key achievements included: /1/ more research outputs and research capacity commercialized by PROs; /2/ improved scientific and technological cooperation; and /3/ more firms investing in R&D activities, e.g. firms co-invested €13.7m, 30% more than the initially envisaged target of €9.2m. After successfully accomplished STP I, the Second Science and Technology Project (STP II) has been launched in 2012.

The second evaluation addressed the BICRO's innovation programmes - RAZUM and IRCRO and UKF Fund which are co-financed by the World Bank in Croatia within the Science and Technology Project, carried out by the Institute of Economics in May 2011 (Radas et al, 2011). The main conclusion is that the RAZUM and IRCRO programmes had a significant impact on the development of innovation, new export oriented products, science-industry collaboration and the promotion of research and innovation capabilities of enterprises. A potential danger is the difficulty of finding funds for the commercialisation of prototypes. It is, therefore, suggested to develop additional programmes that would assist companies in commercialising their new products. The UKF projects have resulted in a number of scientific papers published in international journals, initiating of the new international project cooperation and submissions to EU FP funds.

The most recent third ex-post evaluation study carried out by the Technopolis group (Ohler, 2014) addresses BICRO's programmes RAZUM, IRCRO, TEHCRO (co-financed by STP) and TEST (financed by the government budget) started in October 2013 and delivered results in February 2014. The study positively evaluated the RAZUM, IRCRO and TEHCRO programmes and recommended their continuation with certain improvements. By contrast, it suggests terminating the TEST programme due to its embeddedness in the linear model of innovation with a lack of demand for applications of the technologies resulting from the projects. However, it suggests to substitute this model by a more interactive and collaborative model which would involve the users of research from the beginning of the project. In addition, the study positively evaluated BICRO's performance in implementation of the programmes and concluded that "BICRO has developed not only the basics of funding agencies but also additional skills and capacities, which to a large extent reflect and compensate for various shortcomings in the wider innovation system, particularly of the beneficiaries".

The presented evaluation studies do not provide the analysis of strengths and weaknesses at regional or international level and of emerging opportunities (e.g. smart specialization) and market developments. An effective monitoring and review system, impact analysis or ex ante evaluation tools of research policies and programmes are still not in place. The

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<sup>41</sup> <http://www.worldbank.org/projects/P080258/science-technology-project?lang=en> (February, 2015)

international benchmarking analyses and related set of indicators are mainly carried out in order to participate in international or European databases (e.g. Eurostat, CIS, US, etc.) or for drafting strategic documents. The most recent such strategic documents are: the Strategy for innovation encouragement of the Republic of Croatia 2014-2020, the Draft of the Smart specialization strategy (S3), the Strategy of Education, Science and Technology, the Industrial strategy 2014-2020 and the Partnership Agreement for the European Structural and Investment Funds (PA, 2014) .

In order to draft the Smart specialization strategy (S3) a number of analytical input documents were prepared in cooperation with the EU co-funded team of experts (S3-Expert team) such as: Business expenditure on R&D, Cross-sector competitive advantage analysis, Technology usage and availability including KETs, Research and development, etc.

Apart from the Draft S3 (see Chapter 2.6) and the Industrial strategy 2014-2020 which both identified future areas of development in their respective domains , other foresight exercises or strategic intelligence studies focused on emerging strengths and are not carried out.

A macroeconomic model to assess R&I impact on economic growth is also not in place. However, the World Bank study (2012) tried to estimate the rate of return on R&D compared with possible public investments in education and infrastructure. The estimated rates of returns on R&D (73%) are at least double the value of returns on infrastructure and seven times higher than on education. Yet Croatia's aggregate R&D investments are at a relatively low level (0.9% of GDP in 2011, as compared to 3-5% in innovation-driven economies such as Finland, Sweden and Israel). It is concluded that government should prioritize public expenditures in R&D at the expense of some other sectors since R&D and innovation continues to hold the key to boosting productivity and securing long term development in Croatia.

The National Reform Programme in 2014 envisages the Science and Technology Foresight Project that will be carried out by the MSES in the period 2015-2017. It should encompass three components: creation of comprehensive national information system for science; enabling comparison of data from different actors in R&D system in Croatia, science and technology mapping in the public sector and conducting a first national performance of foresight exercise in R&D sector. In cooperation with MoE through the National Project for Development of Innovation Network for Industry (INI) and creation of the Thematic Innovation Platforms covering mapping in the private sector of R&D, creating INI platform and establishment of the Innovation Council for Industry and Thematic Innovation Councils for the S3 priorities, the institutional framework for RDI policy- making and cooperation between stakeholders should be improved.

However, effective monitoring and review system, benchmarks, foresight studies, intelligence studies are not in place. Some aspects of international comparisons have been carried out within development of the strategic documents like S3 or Industrial strategy 2014-2020. Accurate and comparable information about the quality and efficiency of funding through R&I programmes are missing. Evaluations in policy and programme development are usually not taken into account for improving the public policy programmes.

### **3. National progress towards realisation of ERA**

#### ***3.1 ERA priority 2: Optimal transnational co-operation and competition***

The transitional and regional cooperation entered a new phase upon Croatian accession to the EU since transnational cooperation has become supported by the ESI funds. According to the Partnership Agreement (PA, 2014, p. 150) Croatia will be involved in 13 territorial cooperation programmes in the period 2014–2020, under the ESI funds, these are: /1/ Cross border cooperation with Italy, Hungary, Slovenia, Serbia, Bosnia and Herzegovina and Montenegro /2/ Transnational cooperation with the Central Europe, Danube Programme (EUSDR), Adriatic-Ionian Programme (EUSAIR) and Mediterranean, /3/ Interregional cooperation which include ESPON, URBACT, INTERACT and INTERREG EUROPE.

These programmes include also different aspects of research and innovation cooperation. The transnational programmes include sharing information, joint research agendas, joint calls, joint programming, etc. The evaluation procedures are also envisaged. The policy action at the national level is mainly focused on the establishing of the National Committee for Coordination of Participation of the Republic of Croatia in Programmes of Transnational and Interregional Cooperation and in the EU Macro-regional Strategies for 2014-2020 in order to coordinate the transnational and interregional cooperation. The Committee has been established in September 2013 (60/2013) and will also decide about the aims and priorities of the transnational programmes and allocation of financial resources allocated to Croatia. The Committee is an advisory body of the Croatian government co-chaired by assistant ministers of regional development and EU funds and European and foreign affairs, while its members are representatives of all the relevant participants (competent ministries, NUTS 2 regions, economic and social partners, civil society). Although transnational cooperation includes research and innovation activities the MSES is not included in the work of the Committee.

It is worth mentioning that the research programmes at the national level funded by CSF and MSES do not include these transnational or cross-border cooperative aspects, especially not in joint funding or cross-border flow of grants.

In addition to the mentioned EU Strategy for the Danube Region (EUSDR) and the EU Strategy for the Adriatic and Ionian Region which is in progress. (EUSAIR), Croatia participates in the South East Europe (SEE) 2020 Strategy adopted on 21 November 2013, the Western Balkans Regional R&D Strategy for Innovation (WBRIS) for the period 2014-2020 which has been adopted on 25 October, 2013 and the Danube-INCO.NET project that started in January 2014. All these initiatives are aimed at regional cooperation which should contribute to the cross-border interoperability of national programme, permit joint financing of innovation, and R&D and tackle grand challenges such as supply of energy, water and food, ageing societies, public health, environmental protection, etc. For example, within EUSDR the Danube Region Research and Innovation Fund (DRRIF) is planned to be established to support the coordination of funding mechanisms and funding partners in the region to develop and scaling up joint funding mechanism towards a joint funding programme. A dedicated feasibility study has been contracted to analyse the R&I capacities of the Danube countries, the potential synergy with the existing grant and funding schemes as well as prospective thematic areas of cooperation. The potential scenarios and models of DRRIF were developed and investigation of the political will to



financially support different cooperation models was carried out. This study, in combination with the results of the DANUBE.INCO.Net project will serve as a basis for further steps towards joint activities in R&I in the Danube region.

Croatia participates in the transnational research programmes that include coordination of research priorities, plans and goals, but does not include cross-border flow of funds. It means that each country finances its own research teams and forms a sort of networking of funding. Such transitional programmers are EUREKA - industry-driven research and innovation projects and COST - one of the longest-running European programmes for transnational cooperation in science and technology. The transnational programmes include participation in the transnational large infrastructural projects like CERN, EMBO, EMBL, ALICE, etc. When comes to the ERA-NET type of projects Croatia participates in several initiatives such as ERACOBUILD, SmartGrids, HERA and ERA-NET ASPERA-2.

### ***3.2 ERA priority 3: An open labour market for researchers. Facilitating mobility, supporting training and ensuring attractive careers***

#### **3.2.1 Introduction**

Recruitment and career paths of researchers in Croatia are regulated by national legislation at the level of the central state that classifies Croatia as a country with regulated market for researchers (Doussineau, 2013). The main regulations include the Labour law (OG 149/09 and 93/14), Acts on Amendments to the Act on Science and Higher Education from 2003 (OG, 94/2013 and OG 139/2013) and Collective agreements for science and higher education which determine the general working conditions and researchers' rights and benefits. The regulations which influence hiring of researchers and their career progression by stipulating conditions for promotion into the higher scientific grades and hiring on corresponding job positions include the Ordinance on conditions for scientific titles adopted by NCSHETD (OG 84/2005) (with sequential amendments) and Conditions of Rectors' Conference for the acquisition of scientific-educational-teaching positions. Besides, universities or even university departments (faculties) and institutions authorized for elections usually determine their internal regulations for electing teachers, scientists and collaborators in scientific titles and corresponding jobs.

The process of election into a scientific title can be initiated by a candidate who considers that she or he meets the requirements for the selection and scientific organization with which the applicant has a contract of employment. Application for selection shall be submitted to the one of the scientific organizations authorized to conduct the election procedures for one of the seven scientific disciplines. A candidate should be also registered in the Register of scientists.

Authorized scientific organization appoints an expert committee which consists of at least three members of the same or higher scientific title. The committee shall provide an opinion and suggestion to the relevant scientific field committee. There are 22 such committees by scientific sub-disciplines which evaluate a proposal and make a final decision on the choice of the scientific title. A candidate has no right of appeal against committee decision but can initiate an administrative dispute.

A labour market for researchers in Croatia has been partially reformed in 2013 based on the Act on Science and Higher Education due to the separation of scientific titles from job positions and by introduction of the temporary employment contract for researchers. Candidates appointed to scientific job positions at HEIs and PROs conclude an employment contract for a period of five years with the obligation of re-election or promotion every five years. Three months before the expiry of this five-year period, the competition for the same scientific position is announced by the scientific organisation. If another person is selected as a result, the employee who had previously worked in this position will be offered other suitable positions, or, if there are none, will start the process of termination of employment.

The division between election in scientific title and corresponding job position significantly reduces the possibilities for rapid academic upward career to the highest scientific grades and, more importantly, it limits the multiplication of jobs in the high-ranks high-wage jobs. Yet, the researchers enjoy the status equivalent of civil servants which implies permanent position and job security.

PhD students and post-doctoral students (research novices) are in a difficult position since they have only temporary contracts. Due to the restriction in the number of scientific posts many post-docs will not achieve permanent position after completion of the post-doctoral studies that was previously a usual practice. An employment contract for a post-doctoral position lasts for a maximum of four years after which postdoc must apply for the first-stage permanent scientific position. The transition from post-doc position to the scientific position is increasingly demanding because the number of permanent posts is limited, competition among candidates is growing while selection criteria are tightening. In order to recruit new researchers the state supported two scholarship programmes for young researchers during 2014<sup>42</sup> which enable them to access career development. The doctoral students (who are usually perceived as human resources for knowledge economy) with the expiring employment contract in public sector (HEIs and PROs) will face significant difficulties to find job in the private sector after graduation. The budget cuts and recent reforms of research sector do not allow them to stay in the public sector which was previously a regular practice.

During the five years of economic crisis Croatia has lost around 170,000 jobs. High unemployment is combined with the high level of youth unemployment. Croatia is the 3rd country with the highest share of young unemployed persons reaching 34% in 2013 (Eurostat, 2013) while the first is Greece with 48% followed by Spain with 42%. A share of unemployed persons with higher educational level in Croatia is around 12% of the total number of unemployed which indicates a strong need for reforms not only of labour market but also in the higher education sector. The labour market for researchers is shrinking due to the economic crisis while the higher education system does not contribute to reductions in skills mismatch. It is difficult to assess how many researchers have left Croatia due to lack of jobs, poor working conditions and reduction in wages during the crisis.

Besides, the number of researchers in Croatia has slightly declined during the last decade and oscillates around a little less than 7 thousands researchers (6,688 researchers in 2012, FTE). That accounts for 1.56 researchers per million inhabitants or 47% of average

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<sup>42</sup> The [Research scholarships for professional development of young researchers and post-doctoral students](#) and the [Young Researchers' Career Development Project – Training of Doctoral Students](#)

in the EU-27 (3.29 researchers per million inhabitants). By contrast, the number of researchers in the EU has grown in the same period for 34.4% from 1.22 million in 2003 to 1.64 million in 2012 and has doubled in some countries like the Czech Republic or Slovenia.

### **3.2.2 Open, transparent and merit-based recruitment of researchers**

In the area of open, transparent and merit based recruitment (henceforth OTM) Croatia has made a big progress in the last two years by adoption of the Action Plan for Mobility of Researchers 2011-2012 (a new Plan 2015-2017 is in the process of adoption), Action Plan for Overcoming Obstacles and Enhancing International Mobility in Education for the Period 2010-2012 and the Action plan to Increase Absorption Capacity for Participation in the Framework Programmes (FP7) of the European Union 2013-2015. The main aim of the first Action plans is to remove obstacles for the international and inter-sectorial mobility, while the second one recommends granting work permit for teachers within LLL programme of the EU. The third Action Plan adopted in February 2011 went a step further and recommends by the Measure 9 granting the scientific jobs for exceptional scientists from abroad regardless their nationality and citizenship.

Temporary employment and residence for visiting foreign researchers in Croatia is regulated by the Ordinance on Determining the Requirements for Granting Temporary Residence to Foreigners for the Purpose of Scientific Research (Official Gazette 92/12 and 22/2013) which significantly simplified participation of foreign scientists in research activities in Croatia compared to other foreign workers.

Foreign researcher is also entitled to apply for permanent position at public research organisations what is enabled by the Ordinance amending the Ordinance on the Register of (Official Gazette 82/2010) which removed the Croatian citizenship as a requirement for entry into the Registry of researchers stipulated by the article 6 of the previous Ordinance (OG 72/2004). A foreign candidate should undergo the process of recognition of foreign higher education qualifications (doctoral degree) by the ENIC/NARIC office by the ASHE if required by the public scientific organisation and a full process of election into a scientific title and corresponding job position described above. Besides, as prescribed by the Rectors' Conference a candidate who was first elected to the academic title and teaching position must have inaugural lecture (habilitation) positively assessed by an expert committee appointed by the institution of the employment. However, foreign researchers are usually employed at the first stage scientific position (assistant professor at universities and research associate at research institutes) even though they have already obtained higher scientific titles abroad. The 2013 Law on Science and Higher Education (Article 32, paragraph 8) partially amended the regulation allowing recognition of scientific title obtained abroad.

The rules towards OTM are mostly defined by the Law on Science and Higher Education adopted by the Government on 1 February 2013. The article 40 stipulates that the procedures on recruitment have to be carried out based on public competition and published in the Official Gazette of the Republic of Croatia, on the organisations' websites and on the official web portal for jobs of the European Research Area (EURAXESS Job portal). The vacancy announcement includes the job profile, skills and competences required, and eligibility criteria. Information on the selection process and criteria is usually available for the candidates. A minimum time period between vacancy publication and

deadline for application is 30 days. Applicants have the right to receive feedback on the results. Procedural details of public competition are prescribed solely by the internal acts of the scientific organisation and are based on a general provision from Article 25 of the Basic Collective Bargaining Agreement for Public Servants and Employees. In a case of election to scientific grade (regulated by the Law on Science and Higher Education, Article 35) the candidate does not have right to appeal against decision but can initiate an administrative dispute. The institution shall set up the expert committee which will decide about recruitment. The committee consists of three members of which at least one member cannot be an employee of the scientific organization which carries out the process of recruitment. The composition of the committee is not published and it usually does not include international external members. Despite Croatia made a great progress towards OTM, some analyses (Technopolis, 2014) states that there is greater room for Croatia (as well as for Italy, Bulgaria, Slovenia etc.) in becoming more open and transparent. The randomly check advertisements at Euraxess found that Croatian vacancies often ask for national citizenship and/or native speaker level that does not reflect OTM principles. A random analysis of research jobs published in the Official Gazette of the Republic of Croatia in the period 1 September to 24 December 2014 carried out by the Agency for Mobility and EU programmes showed the following results: out of 781 published vacancies, only 8% asked for the Croatian citizenship as prerequisite for employment. Regarding Croatian language, in 38.5% of vacancies some level of the Croatian language was required (mostly justified and in accordance with the Anti-Discrimination Act (Official Gazette 85/09, 112/12)). Out of all research vacancies published in the Official Gazette between November and 24 December 2014, only 48% was published at the EURAXESS Jobs portal.

Although the precise statistics about researchers' mobility is missing it could be stated that outward mobility is much greater than inward mobility. Croatian PhD students are informally expected to apply for postdoc position in foreign research institutions to acquire international experience. Since 2013 the international mobility is one of the performance criteria for evaluation of research institutions' performance. The main barriers to incoming mobility are language (mostly at universities), low wages and traditional closeness of the Croatian research community. However, foreign researchers can find many benefits to perform their research in Croatia such as excellent information and communication infrastructures, friendly environment, easy communication in English (at PROs) and adequate research premises and campuses. Due to the budget cuts and reforms of the research system all the previous mobility programmes (e.g. EMBO installation grant, CSF's installation grant, UKF's programmes, etc.) were terminated during 2013 and 2014. There is, however, a newly initiated NEWFELPRO 2013-2017 programme whose results of the first call revealed that 2 researchers applied for re-integration grants, 17 for outward and 11 for inward grants.

### **3.2.3 Access to and portability of grants**

Publicly funded grants or fellowships in Croatia are not portable to other EU countries. However, certain funds were accessible to foreign researchers since 2013 when the mobility programmes of the National Science Foundation (e.g. Installation grant for foreign researchers) and the Unity Through Knowledge Fund focused on international cooperation were terminated due to the budget cuts and reforms of R&I system. Foreign researchers are welcome to participate in the "national" projects funded by Foundation but these funds do

not cover fee for researchers what is an important obstacle for the involvement of foreigners in project realisation.

The rules on portability within the he transitional and regional cooperation programmes in the period 2014–2020 under the ESI funds are not fully outlined.

### **3.2.4 EURAXESS**

Euraxess network Croatia has emerged in 2008 from the successfully completed ERA-MORE network (established in 2004) and preceding HR-MOB project carried out in Croatia by the Croatian Agency for Mobility and EU Programmes (AMPEU). The Agency was established by the Act on the Agency for Mobility and EU Programmes in 2007 (Official Gazette 107/07) with the aim to serve as a hub of researchers' mobility and with a view of including them into the single EU labour market.

Euraxess network Croatia exists as part of the public administration system within the AMPEU and provides a complete range of information and support services to researchers and students to strengthen cross-border mobility of and to remove the barriers to free movement of academic staff within Europe.

Euraxess Service Centre consists of the central office located in the capital city of Zagreb and ten Euraxess local contact points. Eight of them are located at the universities (two in Zagreb and one in Osijek, Rijeka, Pula, Split, Zadar and Dubrovnik) while remaining two are located at the Mediterranean Institute for Life Sciences in Split and the Rudjer Boskovic Institute in Zagreb.

Euraxess provides useful information for incoming and outgoing researchers and their families by the 4 editions of the Foreign Researcher's Guide to Croatia, 10 newsletters, and more than 30 workshops, trainings and info-days.

For researchers wishing to pursue research careers in Croatia EURAXESS Croatia helps to find a research position in Croatia and can assist researchers and their families in every step of their move, starting in their home country and continuing until their settlement in Croatia. It provides free personalised service to remove red tape and make the life easier. The assistance provides practical information on accommodation, childcare / school, daily life, health / medical care, info about country / city, intellectual property rights, language courses, recognition of qualifications, social security, funding, taxation, work permits, visa and entry

The office also provides a list of documents (and application forms where possible for all the Procedures needed for entry and stay in Croatia from visa application and health insurance, to identity card or work permit.

The commitment to high-quality free and personalized service of EURAXESS Croatia is based on the Service Commitment. During the project's duration the EURAXESS staffs has replied to over 2000 queries.

According to the Deloitte Researchers' report for Croatia in 2014 (Deloitte, 2014), the number of researchers posts advertised through the EURAXESS Jobs portal in 2013 per thousand researchers in the public sector was 110.4 in Croatia compared with 39.9 among the Innovation Union reference group and an EU average of 43. In 2014, Croatian research organisations published 18800 job vacancies on the EURAXESS Jobs portal and 187 research organisations had registered for this activity. Such an increase in advertising

number of publicly funded research jobs on the central EURAXESS portal have increased the visibility of Croatian research organisations and their prospects for international cooperation.

### **3.2.5 Doctoral training**

Organization of doctoral studies in Croatia is completely autonomous. A doctoral study can be founded by public or private higher education institution in scientific/artistic areas in which the institution responsible for the study is internationally recognized. Establishment of a study programme begins with an initial accreditation of the study programme conducted by the Agency for Science and Higher Education (ASHE) in accordance with the respective regulations<sup>43</sup> and the “Procedures of initial accreditation of study programs” adopted by the ASHE in December 2010. It begins by receiving a request to perform a new study programme submitted to the Ministry of Science, Education and Sports (MSES). The request should contain a detailed elaboration of the proposed doctoral study programme in accordance to the Law of Science and Higher Education and the Instructions for assembling the study programme. The proposal is evaluated by the Expert Committee appointed by the National Council of Science, Higher Education and Technology assisted by the ASHE.

Each university adopts its internal rules on the process of evaluation, setting up and implementation of the doctoral study programmes in accordance with the national regulations. A good example is the Rules of Procedure of evaluation doctoral studies at the University of Zagreb adopted by the Senate in 2011 and Regulations on doctoral studies at the University of Zagreb which regulate all important aspects like: general conditions for establishment, goals, aims and forms of studies, study enrolment, obligation of students and mentors, etc.

Doctoral studies in Croatia can take several forms. The most common is the one for which doctoral study is implemented by the one constituent part or the University which is responsible for it. Other forms include dual doctorate, collaborative study programme, joint study programme, etc. The Doctoral study council, whose composing is determined by the institution(s) responsible for the study, manage the programme in accordance with the regulations issued by the Senate of the university.

The mandatory formats of work in a doctoral study programme are research seminars, workshops and discussion groups, designed for the purpose of developing research work, critical thinking, acquisition of methodology and acquisition of generic skills. Instruction in the format of lectures cannot exceed 20% of the overall load expected by the study programme, measured in terms of ECTS.

Enrolment quotas are determined on the basis of availability of research, teaching and mentorship capacities. The names of the accepted applicants and their qualifications, as well as the names of their reference letter writers, are publicized on the study programme web page. At the time of enrolment, each doctoral candidate needs to submit a written statement on whether he or she intends to study full time or part time. Full time doctoral study takes as a rule three years, and it can be extended to five years if there are justified

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<sup>43</sup> Quality Assurance in Science and Higher Education (Official Gazette, 45/2009) and the Ordinance on the content of license and conditions issuing license to perform activities of higher education, implementation of study programs and re-accreditation of higher education institutions (Official Gazette, 24/2010)

grounds, which is determined by the Doctoral study council. Part time doctoral study takes in principle five years, and it can be extended to seven years.

A doctoral candidate receives a mentor to supervise and direct the research work. The mentor as well as the candidate is required to submit an annual report on the work of the doctoral candidate/mentorship to the Doctoral study council.

Funding of the doctoral students can be provided by the state (only for research assistant or teaching assistant), Croatian or international scholarship, legal person of his/her employer or a doctoral candidate may pay for the study costs by himself/herself.

The doctoral candidate initiates the procedure of doctoral dissertation topic by submitting a request to a committee appointed by the responsible institution that includes three or five members. The proposed topics should be defended publicly before the evaluation of dissertation. Before the dissertation defence, it needs to be determined whether the doctoral candidate has fulfilled all the obligations required by the study programme measured by a certain amount of points collected by requested publications, seminars, presentations, project involvement, etc.

The special measures addressing the Innovative Doctoral Training (IDT) are not carried out in Croatia. However, the main principles of IDT (research excellence, attractive institutional environment, exposure to industry, international networking, transferable skills training and quality assurance) are an integral part of the elaboration submitted to the MSES for establishing the study programmes. These principles are also integrated in the regulations for initial accreditation (evaluation) and re-accreditation of the study programmes carried out by the ASHE as a part of the quality assurance system of HEIs and PROs in Croatia. The evaluation should pay special attention to the relevance of the proposed doctoral study with regard to the to the promotion of social and economic development, needs of private sector and employment opportunities; the merits of the proposed doctoral study on competitive scientific research, and to new ideas, knowledge and skills; Innovativeness, i.e. the ability of the proposed doctoral studies for the creation of new and relevant knowledge or artistic practices; previous experience, international recognition and comparability with similar doctoral programmes in foreign countries.

In order to improve the system of evaluation of the doctoral study programmes the AHSE has carried out the thematic evaluation of the all 125 doctoral study programmes in Croatia (ASHE, 2014) with the main conclusion that the study programmes do not meet the criteria of innovative doctoral training. An urgent and fundamental reform of doctoral studies, which will cover all universities, is needed.

The University of Zagreb initiated a nationwide project in 2013 to provide all Croatian universities with the human resources programmes for sustainable skills development. The project is called Modernising Doctoral Education through Implementation of CROQF (Croatian Qualification Framework) (MODOC) and is carried out in cooperation with six partners: all Croatian public universities and 3 associated partners (Agency for Mobility and EU Programmes, Croatian Employment Service and Young Scientist Network – MLAZ).The overarching objective of the project is to enhance the implementation of the CROQF in the national doctoral education system as well as to develop and modernise doctoral students' qualifications during their doctoral studies by enhancing their professional and personal competences using CROQF standards.

A study on personal and professional competencies of current doctoral students at Croatian universities and the study on Croatian employers' expectations of doctoral

graduates and their competencies<sup>44</sup> were carried out within the project. Following these results the curriculum for the advancement of professional and personal competencies of doctoral students was proposed<sup>45</sup>. In order to contribute to the planned changes in higher education at the national level the Guidelines for Enhancement of Doctoral Candidates' Professional and Personal Competences were presented. The guidelines are intended primarily for HE policy makers and university top management.

### **3.2.6 HR strategy for researchers incorporating the Charter and Code**

The implementation of the "Charter & Code" and HRS4R principles is publicly promoted and supported by the Ministry of Science, Education and Sports, the Agency for Mobility and EU Programmes and the Agency for Science and Education. The main principles of the Charter & Code are incorporated in the national legislation through the Law on Science and Higher Education, Strategy of Education, Science and Technology, Action Plan for Mobility of Researchers 2011-2012, Action Plan to Encourage Investment into Science and Research, Action Plan for Science in Society and EURAXESS portal.

By March 2013, 37 research and higher education institutions have signed the Declaration of Commitment to the Principles of the Charter & Code. Many research institutes and universities have carried out internal analyses to adjust institutional regulations to the principles of Charter & Code with a view to receive acknowledgement and logo by the European Commission for the "HR Excellence in Research" (14 institutions have been successful in this respect). Although there is no special agreements through which national authorities incentivise the effective implementation of the HRS4R, the research institutions are interest in applying the HRS4R principle to successfully pass the evaluation process of re-accreditation (every 5 years) which takes into account also the actions related to HRS4R.

The labour market for researchers is shrinking due to the economic crisis which reduced the number of researchers' post in the public sector and the need for research in the private sector. Croatia is still not considered as an attractive destination for development of research careers. The main obstacles are: low international competitiveness or research groups which is of little relevance for foreign researchers, non-accessibility to national research grants, wages which are below the average of the most EU countries and language barriers.

### **3.2.7 Education and training systems**

The main strategic umbrella document in the development education and training system is the Strategy for Education, Science and Technology 2014-2020 adopted in October 2014 (OG 124/2014). This is a comprehensive document with a numerous measures to improve the R&I&T including the measures for sufficient supply of (post)graduates in science, technology, engineering and mathematics (STEM). The expansion of higher education capacity in the STEM field is considered as a development priority to attain sufficient supply of human resources for future technological development.

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<sup>44</sup> <http://modoc.hr/javno-predstavljene-studije-o-provedenim-istrazivanjima-2/>

<sup>45</sup> <http://en.modoc.hr/odrzana-pripremna-radionica-za-razvoj-kurikuluma-za-unaprjeđenje-profesionalnih-i-osobnih-kompetencija-doktoranada/>



Croatia needs to reach by 2020 35% of people aged 30 to 34 having completed some form of tertiary education what is an achievable goal due to the significant increase in the number of students in the past decade from 121.000 to 157,000. The number of graduates in mathematics, science and technology as % of total graduates are 23.8 while in social sciences, business and law is 42%. On the other hand, as reported by Eurostat, the number of graduates in mathematics, science and technology per 1 000 inhabitants aged 20-29 has tripled in Croatia in the last decade and amounted in 2012 to 17.4% that has surpassed the EU28 average of 17.1%. The number of human resources in science and technology (HRST) as % of active population in Croatia is still low (34.5% in 2013) compared to EU28 average of 43.4% (the smaller shares have only Bulgaria, Portugal, Romania and Slovakia).

The basic mechanism of supporting and motivating students for mathematical skills and science literacy in the primary and secondary schools is the system of facultative and elective courses. The courses are aimed at gifted students who want to take a part in the school competitions that are organised on the local, regional and national level.

Croatia invested many efforts in order to reform the system of vocational education and training (VET) and adult education system which are based on the Vocational Education and Training System Development Strategy of the Republic of Croatia 2008-2013 and the Vocational Education Act (OG 30/2009). The Agency for Vocational Education and Adult Education was established in 2010 by the Law on the Agency for Vocational Education and Training (OG, 24/2010) which follows the previous Agency established in 2005. The Agency is a key stakeholder in the system of vocational education with a task to reform and develop a modern VET system in Croatia.

In order to improve the system of education (up to the level of higher education) the National Centre for External Evaluation of Education (NCEEE) was established in 2004 with the aim to care about the quality assurance of the whole system and especially about the State Mature. The National Human Resources Development Council is appointed in June 2014 by the Croatian Parliament with the function of monitoring the impact of policies of relevant ministries on human resource development in view of national priorities. Despite these efforts the results of PISA 2012 are rather disappointing since Croatia is statistically significantly below OECD average in all aspects of testing: mathematics, reading and science. It is also low-achiever in problem solving while the best results are achieved in financial literacy.

The analysis carried out by the NCEEE about the prevalence of the entrepreneurial contents in programmes of secondary schools (NCEEE, 2012) revealed that entrepreneurship education is incorporated the most important documents in this area - the National Curriculum Framework (NCF) for pre-school education and general compulsory and secondary education adopted in 2011 and „Entrepreneurship Learning Strategy 2010 - 2014“.

The NCF provides a formal framework to educational institutions (kindergartens, primary and secondary schools) to include teaching entrepreneurship as a cross-curricular theme in existing curricula. The goals of the Entrepreneurship Learning Strategy 2010-2014 include raising public awareness about entrepreneurship, introduction of learning entrepreneurship as a key competence and developing key personality traits such as criticality, initiative, organizational skills, leadership, etc.

The Croatian Qualification Framework (CROQF) was adopted in 2013 based on the Act on CROQF (OG 22/2013) and the Rules on the Register of CROQF (OG 62/14 in order to align education with labour market needs, and to develop a new set of occupational and qualification standards and education programmes. The purpose of the CROQF is to reduce the skill gaps on the labour market thereby improving employability and mobility of the working population. Most prominently, the CROQF should link together the qualifications in Croatia with the qualification levels of the European Qualifications Framework (EQF) and the Qualifications Framework of the European Higher Education Area (QF-EHEA). CROQF allows thus the mobility of human resources for continuing education or employment within Europe, and contributes to economic development.

In relation to the quality of doctoral training, in order to ensure that the doctoral programme will be successfully carried out, the Act on Scientific Activity and Higher Education prescribes regular annual reporting and evaluation of research and teaching assistants in science and/or teaching, including by their mentors, as well as reporting upon success in postgraduate study. If the appraisal of an assistant is negative two times in a row, the procedure for termination of employment becomes effective. Scientific organisations evaluate the success of both the work of mentors and assistants every two years.

The Ministry of Science, Education and Sports' Action plan for Mobility of Researchers 2011-2012 contained a chapter dedicated to the development of researcher competences, recognising that professional development and training programmes must be created with the goal of sharpening researcher competences in management, entrepreneurship, research, presentation, communication and administration. It is anticipated that the same will be acknowledged in the Action Plan for the Mobility of Researchers 2016-2018.

The Central Office of Doctoral Studies and Programmes is in charge of providing the necessary tools for the implementation of a skills agenda, and supporting PhD candidates in developing transferable skills. Its aim is to develop communication, management and business skills that will allow PhD candidates to take advantage of their scientific potential during their doctoral training and later in the development of their academic and professional career. Since 2012, the University of Zagreb, in association with international experts has been organising workshops for PhD candidates (15-25 participants per workshop). The workshops are highly interactive and involve a minimum of lecturing with a maximum of group exercises, writing practice and communication within the teams.

Most universities (Zagreb, Split, etc.) are committed to raising awareness of the importance of the implementation of programmes for transferable skills development during doctoral education and to stressing the role of institutions in creating these programmes. To achieve this, a number of events were organised during 2013 and 2014 (mainly in the form of conferences or open days), targeting all those included in the process of doctoral education, be they vice-deans for science, doctoral study directors, supervisors or research team managers.

### **3.3 ERA priority 5: Optimal circulation and access to scientific knowledge**

#### **3.3.1 e-Infrastructures and researchers electronic identity**

In 1995, Croatian government established the [Croatian Academic and Research Network](#)<sup>46</sup> (CARNet), a network of Croatian academic, education (all level) and research community. It provides more than 60 different services to academic community such as e-library, electronic identity, e-mail, e-learning, etc. Within the international cooperation, CARNet follows activities of other academic networks in Europe and participates in the work of international organisations that gather national, educational, academic and research networks.

Croatia has founded in 1971 the [University Computing Center](#)<sup>47</sup> (SRCE) which is one of the key subjects in planning, designing and maintenance of the e-infrastructures at the national level. SRCE actively participates in the EU projects: [GÉANT3](#)<sup>48</sup> - Multi-gigabit Pan-European Research and Education Network and [EGI-InSPIRE](#)<sup>49</sup> - European Grid Initiative: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe. Besides, the SRCE experts participate in the work of international institutions and bodies, such as: [TERENA](#)<sup>50</sup>, [DANTE](#)<sup>51</sup>, ECAM, [GeGC](#)<sup>52</sup>, and many others.

Besides the standard services to citizens and scientists like technical support to public data collections and repositories SRCE also provides the Cloud Virtual Private Server (VPS) (virtual machines for academic and research institutions) and Virtual Computing Lab (VCL) (reserve virtual machines or laboratories with predefined or custom sets of applications and remotely access it over the Internet). SRCE has established the Croatian National Grid Infrastructure - [CRO NGI](#)<sup>53</sup> as a distributed computer environment which is accessible for the purpose of any scientific or research projects that is wholly or partially funded from the state budget. Besides, the most notable is the computer cluster "Isabella" founded in 2002. The "Isabella" is a shared resource of all Croatian scientists which allows the use of important computer possibilities when dealing with difficult data processing as part of scientific-research projects. The "Isabella" is currently being used by fifty scientists from 20 projects. CRO NGI is connected with the biggest world grid project EGI (European Grid Initiative), meaning that users have access to EGI resources as well.

Croatia participates in the [MERIL project](#)<sup>54</sup> (Mapping of the European Research Infrastructure Landscape) which provides through the MERIL portal an inventory of the most excellent research infrastructures (RIs) in Europe. The five infrastructures from Croatia are included: Cloud Infrastructure Services (IaaS): Virtual Computing Lab/ Virtual Private Servers, Croatian National Grid Infrastructure, Data Infrastructure Services, Institute of Oceanography and Fisheries, and Isabella Cluster.

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<sup>46</sup> <http://www.carnet.hr/> (last accessed: 16 February, 2015)

<sup>47</sup> <http://www.srce.unizg.hr/en/> (last accessed: 15 February, 2015)

<sup>48</sup> <http://www.geant.net/Pages/default.aspx> (last accessed: 16 February, 2015)

<sup>49</sup> <http://www.srce.unizg.hr/en/iro/egi-inspire/> (last accessed: 15 February, 2015)

<sup>50</sup> <https://www.terena.org/> (last accessed: 15 February, 2015)

<sup>51</sup> <http://www.dante.net/Pages/default.aspx> (last accessed: 15 February, 2015)

<sup>52</sup> <https://tnc2012.terena.org/web/media/news/id/3162> (last accessed: 15 February, 2015)

<sup>53</sup> <http://www.cro-ngi.hr/> (last accessed: 15 February, 2015)

<sup>54</sup> <http://portal.meril.eu/converis-esf/publicweb/startpage?lang=1> (last accessed: 15 February, 2015)

Open access to scientific information is nowadays increasingly identified with the public research e-infrastructures. Croatia is developing a research e-infrastructure within the international cooperation that is part of the European initiative and participates in the four related projects: [CLARIN](#)<sup>55</sup>, [DARIAH](#)<sup>56</sup>, [ESS](#)<sup>57</sup> and since January 2012 in [SERCIDA](#)<sup>58</sup>.

The national priorities for future infrastructure are provided by the [Croatian Research Infrastructure Roadmap 2014-2020](#)<sup>59</sup> adopted on 1 April 2014 by the MSES. It also provides selection criteria for RI projects, implementation of the pan-European research infrastructures (ESFRI projects) and the Indicative list of RI project proposals for ERDF 2014-2020. The total envisaged funds amount to €319m of which 20% should come from the national resources.

The authentication and authorization infrastructure of the Croatian research and education community is developed within the [AAI@EduHr](#)<sup>60</sup> project in 2006 carried out and maintained by SRCE. AAI@EduHr today covers complete Croatian research and education community with 22 identity providers with over 680.000 electronic identities and over 230 services that utilise those identities. It provides a uniform, reliable, easy to use and secure access to network and networked resources. AAI@EduHr is opened for international cooperation and cross-federation connections. Furthermore any organisation providing services to the target community might join AAI@EduHr as a partner service provider.

The concept, structure and organisational model of the AAI@EduHr are defined by the Regulations on the organization of authentication and authorization infrastructure of science and higher education in Croatia- AAI@EduHr. The Regulations also define the obligations of all subjects involved in the infrastructure as well as the operational procedures.

AAI@EduHr is an official member of the inter-federation platform [eduGAIN](#)<sup>61</sup> which intends to link services and users worldwide. The eduGAIN service enables the trustworthy exchange of information related to identity, authentication and authorisation between the GÉANT (GN3plus) Partners' federations.

AAI@EduHr is also a member of the global roaming service [eduroam](#)<sup>62</sup> which secures, world-wide roaming access service developed for the international research and education community. The eduroam allows students, researchers and staff from participating institutions to obtain Internet connectivity across campus and when visiting other participating institutions by simply opening their laptop.

In 2003, Croatia adopted the Act on Personal Data Protection which regulates collecting, processing and use of personal data in Croatia in order to protect the personal data, the privacy of individuals, as well as other human rights and fundamental freedoms. The Act closely tracks the principles of the EU Data Protection Directive 95/46/EC in order to be aligned with the *acquis communautaire* and was subsequently amended in 2006, 2008 and 2011. For example, international data transfers outside of Croatia are only allowed

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<sup>55</sup> <http://clarin.eu/> (last accessed: 15 February, 2015)

<sup>56</sup> <https://www.dariah.eu/> (last accessed: 15 February, 2015)

<sup>57</sup> <http://www.europeansocialsurvey.org/> (last accessed: 15 February, 2015)

<sup>58</sup> <http://www.serscida.eu/hr/> (last accessed: 15 February, 2015)

<sup>59</sup> <http://public.mzos.hr/fqs.axd?id=21801> (last accessed: 15 February, 2015)

<sup>60</sup> <http://www.aaiedu.hr/> (last accessed: 15 February, 2015)

<sup>61</sup> <http://www.geant.net/service/eduGAIN/Pages/home.aspx> (last accessed: 15 February, 2015)

<sup>62</sup> [http://www.eduroam.hr/?locale=en\\_EN](http://www.eduroam.hr/?locale=en_EN) (last accessed: 15 February, 2015)

when an adequate level of protection of personal data is ensured (unless derogation applies). Additionally, the Act requires data controllers to maintain records of their processing activities, which must be submitted to the Personal Data Protection Agency for compilation in a Central Register.

In addition, Croatia has enacted several specific laws and regulations. For example, the Electronic Communications Act implements the e-Privacy Directive 2002/58/EC, as amended by Directive 2009/136/EC, and the Regulation on the Procedure for Storage and Special Measures Relating to the Technical Protection of Special Categories of Personal Data sets forth detailed information security measures.

The Croatian Personal Data Protection Agency monitors compliance with the Act on Personal Data Protection.

### **3.3.2 Open Access to publications and data**

Croatian Government encourages open accessibility to the results of publicly funded research within Croatia. The Ministry of Science, Education and Sports supported the [Croatian scientific portal](#)<sup>63</sup> a project that marked the beginning of open access in Croatia in 2006 carried out by the Library of the Rudjer Boskovic Institute and SRCE. The Portal combines, in one place, all information about Croatian scientists, their papers, research projects, Croatian journals and scientific instruments. The aim is to provide better interconnection between scientists as well as promotion and popularisation of science in Croatia and abroad. For the past two years the portal has grown into an indispensable source of relevant information about science and it averaged more than 20.000 visits per day. The Portal provides several informational services which afford open access to all scientific information resulted from public funding research, as follows: the Croatian scientific bibliography - [CROSBI](#)<sup>64</sup>, the Croatian scientific journals portal - [HAMSTER](#)<sup>65</sup>, the Who's who in Croatian science and Registry of the large scientific equipment at HEIs and PROs- [CALIPER](#)<sup>66</sup>

CROSBI is the digital repository which has been collecting bibliographic data of the publications written by Croatian researchers since 1996. The repository currently has over 213.000 bibliographic records with an average of 20.000 records per year. CROSBI serves also as a central open access (OA) repository for more than 5.000 publications which are archived by the authors themselves.

HAMSTER was built in the year 2006 and offers access to 168 digital versions of Croatian scientific and professional journals, which follow the initiative of Open Access and support meta-data exchange according to OAI PMH Protocol (Protocol for Metadata Harvesting). OA publishers have, thanks to the HAMSTER, a high quality platform for publishing their journals while researchers have the access to the full-text database of scientific publications, published in the Croatian journals. Currently HAMSTER holds more than 28.000 articles with full-text which are regularly downloaded by other thematic and interdisciplinary OA repositories (OALster, Base, Google Scholar and Scopus).

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<sup>63</sup> [http://www.znanstvenici.hr/index\\_en.php](http://www.znanstvenici.hr/index_en.php) (last accessed: 15 February, 2015)

<sup>64</sup> <http://bib.irb.hr/index.html?lang=EN> (last accessed: 15 February, 2015)

<sup>65</sup> <http://hrcak.srce.hr/> (last accessed: 5 February, 2015)

<sup>66</sup> <http://sestar.irb.hr/> (last accessed: 15 February, 2015)

Due to the CROSBİ and HAMSTER which offer full-text databases prior or in time of publishing (authors' uploading), the Croatian model is closest to the "Immediate Deposit/Optional Access model" of open access.

Who's Who in Science in Croatia unifies in one place structured data about more than 6.000 Croatian scientists and provides links to the CROSBİ bibliographic data. The main goal of the project is to promote Croatian scientists in the country and abroad, and to improve communication and information exchange between scientists themselves.

An examination of OA availability (Archambault et al., 2014) revealed that Croatia is among four EU28 countries which have reached an aggregate availability score above 70% together with the Netherlands, Estonia, and Portugal. However, Croatia is one of the member states with the least proportion of green OA (5.2%) while the proportion of Gold OA journal is rather high (23%) and other OA is 38.9%. The higher proportion of green papers in Croatia is in the field of Physics & Astronomy (44%), ICT (6%) and Mathematics & Statistics (6%). The higher proportion of gold papers is in Philosophy and Theology (95%), in General Science and Technology (74%), Physiology and Cognitive Sciences (57%) and Economic and Business (55%).

## **4. Innovation Union**

### ***4.1 Framework conditions***

In general, business environment in Croatia is not conducive to innovation. Demand-side policies and instruments stemming towards increasing business investments in research and innovation practically do not exist. Main supporting measures providing incentives for businesses to invest in R&D are tax incentives, with addition of several programmes aimed at funding of innovation activities, which can also be classified as supply-side policies. In 2011, an analysis of R&D tax incentives (Aralica et al., 2011) resulted in a conclusion that tax incentives in Croatia are more generous form of state aid for R&D than subsidies. Namely, several large business R&D performers claim tax incentives that exceed the overall public R&D subsidies, as it can be seen in corporate financial reports. For example, in 2009 subsidies amounted to less than a third of aid granted by the tax incentives. Although over 270 companies used tax incentives, 90% of the total tax incentives have been realized by a small number of companies: 9 in 2008 and 27 in 2009. This indicates that the a few companies conduct large research projects and the concentration of tax incentives into the small number of users is present. Although it is expected that different forms of demand-side policies will be introduced in the coming period (as presented in the recently adopted Strategy for innovation encouragement of the Republic of Croatia 2014-2020), currently there are practically no demand-side policies in place in Croatia so far, which significantly influences innovation performance of both public and private institutions.

### ***4.2 Science-based entrepreneurship***

Although the problem of weak linkages has been recognised as one of the main problems of Croatian innovation system, actual support schemes aiming to facilitate knowledge transfer and the creation of university spin-offs have not been developed until recently. Within the STP II project, Technology Transfer Office Support Program was launched by HAMAG-BICRO in February 2015. One of its goals is to provide support to TT Offices in the process of creation of university spin-offs. In this area, there are also problems regarding the IP at Croatian universities, as elaborated in section 4.3. In addition, venture capital and equity finance are still highly underdeveloped, leaving start-ups to orient towards bank lending and leasing mechanisms, usually reluctant to provide finance to risky investments.

When it comes to supporting young innovative companies, several supporting schemes have been developed over the last decade. However, most of them are currently suspended, mostly because of structural changes in the national innovation system (primarily merger of Business Innovation Agency of Croatia – BICRO and Croatian SMEs agency – HAMAG Invest).

Business Innovation Agency of Croatia (BICRO) developed several support measures in 2007, aiming at providing funding to innovative SMEs, supported through the World Bank loan (Science and Technology Project), including Development of Knowledge-Based Companies Programme – RAZUM and Venture Capital Programme – VENCRO, an public-private partnership initiative to encourage potential fund managers to start venture capital funds in Croatia. However, difficulties in finding an appropriate private partner prevented the actual implementation of the measure. RAZUM programme provides financing to start

SMEs for projects at a pre-commercial development phase. In the period 2007-2012, 24 projects have been approved for funding from the RAZUM programme, with contracted funding of € 15 million.

The [Proof of Concept \(PoC\) Programme](#)<sup>67</sup>, also administered by HAMAG-BICRO, has been introduced in 2010. The programme was created to ensure pre-commercial capital for technical and commercial testing of innovation concepts. So far, PoC has achieved significant results in terms of the number of applications and the quality of applied projects. Its evaluation procedures are transparent and effective, which is one of the reasons for the continuous increase in the number of applications.

The new [Croatian Agency for Small Business, Innovation and Investment – HAMAG-BICRO](#)<sup>68</sup> implements the programme "[Business impulse](#)"<sup>69</sup>, which is the Government programme to encourage small businesses and crafts, which includes support for innovative entrepreneurship. The programme is funded from the EU Structural funds and national resources with a total budget of €46m in 2014. The BICRO's programmes have been integrated within the Business impulse programme.

### **4.3 Knowledge markets**

Intellectual property protection in Croatia is rather well regulated and falls under the responsibility of the [State Intellectual Property Office \(SIPO\)](#)<sup>70</sup>. The development course of the intellectual property system in Croatia has been set by the [National Strategy for the Development of the Intellectual Property System of the Republic of Croatia for the period 2010 – 2012](#)<sup>71</sup>, which identifies the following strategic development goals:

- The adaptation of the legislation framework in the field of intellectual property rights by its harmonisation with the EU *acquis communautaire* and international legal order in the field of intellectual property;
- Improvement of the national intellectual property system (NIPS) institutional framework, primarily through the development of institutions, modernisation of methods and procedures, development of human resources and increasing the level and transparency of cooperation between stakeholders in the NIPS;
- Improvement of the national intellectual property infrastructure and its integration into the global one;
- Improvement of the use of intellectual property;
- Increasing the level of recognition and respect for the IPR through raising public awareness about the importance of intellectual property and increasing the efficiency of the legal enforcement of rights;
- Regional and global integration of NIPS and active international cooperation.

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<sup>67</sup> <http://www.hamagbicro.hr/inovacije/privatni-sektor/poc-za-poduzetnike/> (last accessed: 25 February 2015)

<sup>68</sup> <http://www.investcroatia.hr/> (last accessed: 25 February 2015)

<sup>69</sup> <http://www.minpo.hr/default.aspx?id=535> (last accessed: 25 February 2015)

<sup>70</sup> <http://www.dziv.hr/en/> (last accessed: 25 February 2015)

<sup>71</sup> [http://www.dziv.hr/files/File/strategija/Strategy\\_IP\\_2010\\_12.pdf](http://www.dziv.hr/files/File/strategija/Strategy_IP_2010_12.pdf), (last accessed: 25 February, 2015)



SIPO information centre – INCENTIVE, was developed as a result of a CARDS 2003 project Intellectual Property Infrastructure for the R&D Sector – Promoting research institutions – SME interactions. Through the INCENTIVE, SIPO provides professional information assistance, services and educational programs intended for universities, public research institutes, and business sector (SMEs) with the aim of effectively protecting, utilising or managing intellectual property.

There have been no recent initiatives aimed at protecting and enhancing the value of intellectual property and boosting creativity. There is a need for introducing additional supporting mechanisms and regulation in the area of IPR on Croatian universities. This specific area is stipulated by the Labour Act, which primarily regulates inventions and relations between the inventor (employee) and employers and provides the rights of appropriation to the employers. In practice, the higher education institutions are provided with free disposition of the intellectual property rights, resulting in low levels of spinouts and start-ups creation.

#### **4.4 Knowledge transfer and open innovation**

Development and promotion of academia-industry cooperation is considered as one of the main national priorities for the development of Croatian economy, and has been included in the [Strategy for Education, Science and Technology](#)<sup>72</sup>, [Industrial Strategy 2014-2020](#)<sup>73</sup>, [Strategy for innovation encouragement of the Republic of Croatia 2014-2020](#)<sup>74</sup> etc. Besides the programmes funded by the European Union, Croatia has developed several programmes aimed at fostering cooperation between public research organisations and industry. Most of these programmes were developed with the support of the World Bank loan, through the Science and Technology Project. However, some of them have currently been suspended and there is no indication on their continuation. IRCRO and RAZUM are currently the only open programmes aimed at innovation development and implemented by [HAMAG-BICRO](#). It is expected that POC (Proof of Concept programme) will be opened in 2015.

Some of the most important measures supporting R&D cooperation and knowledge transfer between public and private sectors include [Technology-oriented projects \(TEST\)](#)<sup>75</sup>, [Collaborative research development programme \(IRCRO\)](#)<sup>76</sup>, [Development of the knowledge-based companies programme \(RAZUM\)](#)<sup>77</sup> and [Science and Innovation Investment Fund](#)<sup>78</sup>.

TEST programme provided funding for applied research in the field of (high) technologies. Eligible applicants were scientific organisations registered at MSES. It was previously managed by the Croatian Institute of Technology (HIT), which was merged with BICRO.

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<sup>72</sup> <https://www.azvo.hr/hr/novosti/1061-strategija-obrazovanja-znanosti-i-tehnologije> (last accessed: 25 February 2015)

<sup>73</sup> [http://www.mingo.hr/userdocsimages/industrija/Industrijska\\_strategija.docx](http://www.mingo.hr/userdocsimages/industrija/Industrijska_strategija.docx) (last accessed: 25 February 2015)

<sup>74</sup> [http://www.mingo.hr/public/documents/Strategija\\_poticanja\\_inovacija\\_18\\_12\\_14.pdf](http://www.mingo.hr/public/documents/Strategija_poticanja_inovacija_18_12_14.pdf) (last accessed: 25 February 2015)

<sup>75</sup> <http://www.hamagbicro.hr/inovacije/javni-sektor/test/> (last accessed: 25 February 2015)

<sup>76</sup> <http://www.hamagbicro.hr/inovacije/privatni-sektor/ircro/> (last accessed: 25 February 2015)

<sup>77</sup> <http://www.hamagbicro.hr/inovacije/privatni-sektor/razum/> (last accessed: 25 February 2015)

<sup>78</sup> <http://siif2.com/siif/eng/> (last accessed: 25 February 2015)

Today, TEST is managed by HAMAG-BICRO. All projects financed by TEST are completed and there are currently no public calls opened.

The Research and Development Programme (IRCRO) aimed at encouraging SMEs to establish R&D activities and cooperate with PROs. The programme was designed to encourage and stimulate the demand for services of public research institutions, as well as to encourage SMEs to invest in R&D activities.

RAZUM Programme is oriented towards supporting commercialisation of products and services developed on the results of R&D activities. The Programme provides funding to technology oriented knowledge-based start-ups and SMEs for development of projects in pre-commercial stage – so called pre-commercial projects. Through RAZUM, commercial projects have also been evaluated, but funding for these projects has been awarded by [Croatian Bank for Reconstruction and Development \(HBOR\)](#)<sup>79</sup>.

Science and Innovation Investment Fund (SIIF) is a project implemented by MSES and funded through EU IPA IIIc. The project supports technology transfer and commercialisation of universities' research results. SIIF has been divided in two phases. Within the first phase, five projects received funding of €5million, while the second phase has been planned to end in 2015.

When it comes to incentives and rewarding academics engaged in cooperation with industry, and measures supporting open innovation and circulation of knowledge, currently there are no such mechanisms in place.

#### ***4.5 Innovation framework for SMEs***

In 2012, Croatian Government adopted the Act on Financial operations and Pre-Bankruptcy Settlements. The Act regulates financial operations of undertakings, terms of fulfilment of financial obligations and legal consequences of delays, process of pre-bankruptcy settlements, financial control of companies and legal persons with public authorities and other issues. Under this Act, business undertakings as debtors are granted the possibility to request commencement of pre-bankruptcy settlement proceedings in order to avoid regular bankruptcy proceedings and to get the possibility to ensure a going concern of the business. Therefore, there are some measures supporting the financial reorganisation of enterprises. However, there are almost no possibilities for SMEs to reprogram their debts towards the Tax Administration, which usually lead to account blocking, regardless of the size of the debt.

The opportunities for innovative SMEs are increasing due to established and new support schemes co-financed by the ERDF. In addition to access to finance, co-financing of new equipment purchases and support to R&I projects, other support measures include knowledge sharing platforms such as competitiveness clusters, which are also expected to facilitate science-industry collaboration. There are no innovation voucher schemes in Croatia, but their introduction has been included in the Strategy for innovation encouragement of the Republic of Croatia 2014-2020.

There is a need for increased effectiveness and efficiency of policy implementation. Selection criteria of significant part of implemented support measures are vague, making

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<sup>79</sup> <http://www.hbor.hr/Sec1237> (last accessed: 25 February 2015)

the applications more difficult to prepare and selection process more dependent on evaluators' subjective appraisal. Evaluation procedures remain rather underdeveloped, but some improvements have been made towards ensuring effective evaluation of implemented programmes and their revision based on the evaluation results.

Other barriers for development of innovation and entrepreneurship in general include complex administration, unnecessary bureaucracy, long and complex procedures to obtain necessary licences as well as high regulatory fees.

#### **4.6 Venture capital markets**

Venture capital funding in Croatia is still largely underdeveloped. There were some initiatives over the last decade, however these were not successful. There is some business angel activity, mostly through CRANE (Croatian Business Angel Network). Current investments are still rarely targeted at early stage financing; they often focus on financial operations related to restructuring of more mature companies.

In 2011, several Economic Cooperation Funds have been established on the Government initiative. Economic Cooperation Funds (ECFs) are open-end venture capital investment funds with private offering that have been established and operate in accordance with the Alternative Investment Funds Act. ECFs have been established on the *pari passu* principle – investor in each ECF with 50% is the Republic of Croatia, while other 50% are invested by private investors. In the case of ECFs these are pension funds, banks and companies. Croatian Bank for Reconstruction and development (HBOR) is a qualified investor appointed by the Government of the Republic of Croatia, which participates in the implementation of ECFs' activities together with private investors.

ECFs have mainly operated as private equity funds that have invested in restructuring of existing enterprises temporarily affected by the economic crisis, although there have also been some investments into early stage ventures. Beneficiaries are companies with the seat in Croatia, active predominately in Croatia, with a high growth potential and competitive advantage.

The start-up scene is becoming increasingly internationalised. Croatian start-ups often take part in international events and competitions, which increases their visibility and attractiveness to potential investors. Occasionally, foreign venture capital funds invest in start-ups and early stage ventures in Croatia, but that is sometimes related to a partial dislocation of their activities outside of the country.

Country attractiveness for investment in Venture Capital and Private Equity assets is low. [The Venture Capital and Private Equity Country Attractiveness Index \(VC&PE index\)](http://blog.iese.edu/vcpeindex/ranking-2014/)<sup>80</sup> ranked [Croatia](#) at the 64<sup>th</sup> place out of 118 countries in 2014. Low ranks were recorded in the dimensions Economic activities (89<sup>th</sup> place; weak performance in Expected Real GDP Growth and Unemployment), Human and Social Environment (82<sup>nd</sup> place; particularly due to Labour Regulations) and Investor Protection and Corporate Governance (79<sup>th</sup> place). Better ranking was achieved in the dimensions of Taxation (31<sup>st</sup> place) and Entrepreneurial Opportunities (47<sup>th</sup> place; due indicators of Innovation, Scientific and Technical Journal Articles and Corporate R&D).

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<sup>80</sup> <http://blog.iese.edu/vcpeindex/ranking-2014/>

There is awareness of the policy gaps in this area. The recently launched Business impulse programme for 2015 envisages introduction of new support measures e.g. seed investments (through setting up the Croatian Seed Fund, which should have € 2.5 million at their disposal) and early stage co-investments into innovative SMEs (which will complement investments by founders, business angels, VC funds etc.), with € 0.9 million available in 2015.

#### ***4.7 Innovative public procurement***

Public procurement procedures are based on the Public Procurement Act, which does not distinguish innovative goods and services from other goods and services. In addition, no innovation-oriented procurement policies exist in Croatia. In general, development of innovation was not recognised as one of national development priorities until very recently. Strategy for innovation encouragement of the Republic of Croatia 2014-2020 does recognise the need of using specific procurement procedures to boost development of innovation. However, the Strategy has been adopted only recently (December, 2014), and specific measures enabling the development of public procurement procedures serving innovation development have not entered into force.

## **5. Performance of the National Research and Innovation System**

### ***5.1 Performance of the National Research and Innovation system***

In 2012, Croatia produced 13.94 publications per 10,000 inhabitants on average, which is around the EU-28 average (13.8). International orientation is still quite low with 32.49% of publications internationally co-published. In 2012, Croatia had about 453 international scientific co-publications per million population. In the period 2002-2012, less than 5% of the Croatian scientific publications were in the top 10% most cited publications worldwide in comparison with 11% of top scientific publications produced in the EU28 (Science Metrix, 2014)<sup>81</sup>. The share of public-private co-publications in Croatia is 0.8%% in the period 2008-2013 against 2.8% for the EU28<sup>82</sup>.

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<sup>81</sup> These publication data are based on Elsevier's Scopus database. ScienceMetrix, Analysis and Regular Update of Bibliometric Indicators, study conducted for DG RTD. They represent an update of the data displayed in the table below. See also [http://ec.europa.eu/research/innovation-union/index\\_en.cfm?pg=other-studies](http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=other-studies).

<sup>82</sup> SciVal 2014, Scopus based publication indicators derived from Elsevier's SciVal platform, [www.scival.com](http://www.scival.com) last accessed December 2014.

**Table 2. Assessment of the Performance of the National Research and Innovation System**

<b>1. ENABLERS</b>	Year	HR	EU
<b>Human resources</b>			
New doctorate graduates (ISCED 6) per 1000 population aged 25-34	2011	N/A	1.70
Percentage population aged 30-34 having completed tertiary education	2012	23.70	35.80
<b>Open, excellent and attractive research systems</b>			
International scientific co-publications per million population	2012	427.50	343.15
Scientific publications among the top 10% most cited publications worldwide as % of total scientific publications of the country	2009	3.18	10.95
<b>Finance and support</b>			
R&D expenditure in the public sector as % of GDP	2012	0.41	0.75
Venture capital (early stage, expansion and replacement) as % of GDP	2012	N/A	0.08
<b>2. FIRM ACTIVITIES</b>			
R&D expenditure in the business sector as % of GDP	2012	0.34	1.31
<b>Linkages and entrepreneurship</b>			
Public-private co-publications per million population	2011	27.38	52.84
<b>Intellectual assets</b>			
PCT patent applications per billion GDP (in PPSE)	2010	0.73	3.92
PCT patent applications in societal challenges per billion GDP (in PPSE) (climate change mitigation; health)	2010	0.23	0.85
<b>3. OUTPUTS</b>			
<b>Economic effects</b>			
Contribution of medium and high-tech product exports to trade balance	2012	1.03	1.27
Knowledge-intensive services exports as % total service exports	2011	17.31	45.26
License and patent revenues from abroad as % of GDP	2012	0.05	0.59

Source: European Commission, IUS Database (2014).

Innovation Union Scoreboard (IUS, 2014) evaluated Croatia as a moderate innovator with one of the lowest innovation growth rate in the period 2006-2013. The performance gap between Croatia and the EU has decreased from 60% in 2011 to 55% in 2013. Croatia is performing well below the average of the EU for most indicators, most notably for Intellectual assets (Community designs, Community trademarks, PCT patent applications in societal challenges) and in License and patent revenues from abroad. Croatia's main strengths are in International scientific publication, the Non-R&D innovation expenditures, the new doctorate graduates and the Youth with upper secondary level education.

## ***5.2 Structural challenges of the national R&I system***

The following main structural challenges can be identified:

### **1. The R&D policy lacks coherent and integrated policy framework**

Under the present financial constraints, the science policy actions are focused on two goals: rationalisation of public research sector in order to achieve savings of the state budget and establishing better quality of scientific research at the same time. Ambitious agendas that aim to provide some entirely new possibilities for science in economic recovery and socio-cultural changes are not a subject of the current policy. A new Industrial policy that could provide a framework for science and technology strategic role is not devised. Policy makers tend to neglect that research and innovation hold the key to boosting productivity and securing long term development<sup>83</sup>. However, several new strategic documents which were recently adopted, such as the Strategy of Education, Science and Technology and the Strategy for innovation encouragement of the Republic of Croatia 2014-2020, have brought some new strategic recommendations.

The present science policy suffers from the lack of coordination between government bodies responsible for research and innovation policy (MSES, MoE, MoEC and MRFEEU) since their policies and supporting measures are not harmonised and related in such a way to produce a synergy in innovation and technological development. These issues might be solved by implementation of the new strategies and overall reconstruction of the Croatian national innovation system, but this remains to be seen in the upcoming months.

### **2. Business environment is not conducive to innovation**

Overall business environment in Croatia creates disincentives to innovation. Its key features include inefficient state administration (sometimes prone to political voluntarism), financial system dominated by banks (with relatively shallow and illiquid capital market), high costs of utilities and local services, widespread illiquidity and weak linkages between education sector and the labour market. According to the results of the Global Competitiveness Report for 2014-2015 (WEF, 2014) Croatia is positioned at 77th place out of 144 countries. The most problematic factors for doing business in Croatia include, according to WEF, inefficient government bureaucracy, policy instability, corruption, tax regulations, tax rates, access to financing and restrictive labour regulations, etc.

### **3. Weak interest of private companies for research and development**

The volume and investment of private businesses R&D remains at low levels, with low interest in cooperation with the public R&D sector. Economy is dominated by the large and un-reformed public companies that are not exposed to market competition which would urge them to innovate. A new layer of SME is composed of sectors which are not based on research and innovation and consists largely of micro companies with less than 10 employees, having modest capacities to perform or absorb research. The wholesale and

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<sup>83</sup> According to the World Bank calculations (World Bank, 2012a), the social rate of return on R&D investments in Croatia is estimated to 73%, more than twice, for instance, the rate of return for infrastructure. Yet Croatia's aggregate R&D investments are at a relatively low level (0.9% of GDP in 2011, as compared to 3-5% in innovation-driven economies such as Finland, Sweden and Israel.

retail trade sector, construction, accommodation and restaurants make nearly 50% of all SMES (MEC, 2012).

Micro and small enterprises account for low share of total investments in R&D, reaching very low shares compared to European countries. On the other hand, the share in total business investment in R&D coming from medium sized enterprises is higher than in most other European countries. The analysis conducted several years ago (MEC, 2012) indicate that, overall, SMEs invested less than 1% of total revenues in research and development, an amount of around €88 million in 2008.

There is a strong concentration of R&D expenditure on relatively few companies while innovation and R&D occupy a marginal role in the development strategies of the most of Croatian companies. Innovations are mainly incremental and forced by survival on the domestic market rather than a result of meaningful and long lasting strategy for competition on international markets.

#### **4. Uncompetitive research and higher education system**

Croatian universities are mostly fragmented and faculties are usually organised as individual legal persons, rather than departments of one legal person, i.e. university. This leaves individual faculties with significant autonomy which negatively affects the level of integration of Croatian universities, especially when it comes to possibility of fast adaptation to international competition. Consequently, there are also significant obstacles when it comes to commercialisation of research results and development of science-industry linkages.

Reforms of the science and higher education system have been finally initiated by the adoption of the Act on Science and Higher Education July 2013. The Act introduced significant changes in the science system, aimed at improvement of the international recognition and competitiveness of the Croatian research groups and institutions, as well as to gain the value for the invested public money by increasing the social responsibility and economic accountability of PROs and HEIs.

The Act introduced the new funding model of scientific activities which now includes institutional funding for multi-annual research programmes based on performance indicators and allocation of competitive research grants by CSF. Allocation of funding is based on rigorous evaluation procedures to finance a smaller number of high quality projects. However, some of the proposed changes have not been accepted, such as tightening the criteria for obtaining scientific titles.

#### **5. Weak regional research and innovation systems**

There are significant regional disparities in Croatia, primarily based on significant differences on the average incomes between the regions. For example, average incomes are three times higher in the richest regions than in the poorest ones. The difference is about 1% to 3.1% of GDP per capita and does not decrease (RCIC, 2011). Despite this, regional research and innovation policies practically do not exist. There were several attempts to tackle with this issue (e.g. introduction of Regional Development Strategy of Croatia 2011-2013 and development strategies on county level), but these were significantly uncoordinated and did not achieve notable results. There are high expectations from ESI funds as a mean to boost development of less developed Croatian regions. However, the current state of readiness of projects which are to be submitted for EU co-funding indicates concentration of infrastructural projects in Zagreb and few larger



regional centres such as Rijeka. Strengthening of regional research and innovation systems will require improvements of capacities for R&I funds absorption across Croatia.

### ***5.3 Meeting structural challenges***

In the area of R&D policy, significant developments have occurred during 2014. These primarily include the adoption of the Strategy of Education, Science and Technology and Strategy for innovation encouragement of the Republic of Croatia 2014-2020. While the Strategy of Education, Science and Technology offers recommendations for the comprehensive reform of the Croatian education system, the Strategy for innovation encouragement of the Republic of Croatia 2014-2020 has brought about 40 guidelines oriented towards facilitating development of innovations in Croatia. These highly anticipated strategic documents have introduced some new insights that can improve the policy approach to fostering innovation and productive use of knowledge, but their implementation remains to be observed.

Although the creation of business environment conducive for innovation remains as one of the primary national development priorities, there were no significant changes in the innovation system or business sector that could significantly contribute towards increasing the innovation performance of Croatian companies. Government has tried to initiate many reforms in order to improve business climate, but reforms have so far been insufficient to eliminate the structural problems that hamper the country's growth potential.

Due to the complexity of business environment, policy response needs to be comprehensive and coordinated. In the case of Croatia, policy response has been fragmented and partial. Consequently, it has not reached the required level of appropriateness, effectiveness and efficiency. In addition, state administration reform at central and local levels have not advanced much. Access to capital still remains one of the most important problems of innovative companies, with insufficient availability of credit and equity financing. EU funding is expected to partially alleviate the latter problem.

The Croatian SME Observatory Report for 2012 and 2013 (MEC, 2012, 2013) presented many important features of SME sector in Croatia including very modest investments in innovation and R&D.

The MoEC programme – Business impulse, is aimed at upgrading business infrastructures, foster uniform regional development, develop SMEs and clusters, encouraging the implementation of innovations and new technologies, etc. These efforts remain uncoordinated with the efforts of the Ministry of Science, Education and Sports (MSES).

While the policy measures for fostering R&D in SMEs have been appropriately designed, they have mostly been suspended during 2014, with no indication on their continuation in the upcoming period.

Tax exemptions are mostly claimed by medium-sized and larger companies, as it has been elaborated by the Institute of Economics. This measure is appropriate, efficient and effective. It has been particularly important for international competitiveness of several Croatian subsidiaries of transnational corporations. Tax exemptions are conducive to their parent companies allocating their R&D budgets to Croatia.

Reforms of the higher education system have been initiated during 2013 and 2014. The Decision on multi-annual institutional financing radically changed the system of financing

research activities from the State budget which has been in force since 1991. The awarding of project research grants is entrusted to the CSF and assumes a rigorous evaluation process that should end up with a smaller number of high quality research projects, up to 250 per call per year. This can put at risk significant segments of the national scientific base since Croatia has a relatively narrow financial base for scientific research due to low interest of private sector and a lack of diversified resources for competitive research funding. Strategy of Education, Science and Technology, adopted in October 2014, recommends significant reforms of the overall education system, ranging from preschool to higher education. However, proposed reforms can seem somewhat radical and their actual implementation remains to be seen in the future.

When it comes to regional innovation systems, there are practically no strategies or policies regulating the matter. Development of the regional development strategies, planned to be adopted for the period 2014-2020, has been postponed due to delay on the national level in the development of the national regional development strategy and Act on Regional Development, which will enter into force in January 2015. Therefore, regional development strategy, prepared for the period 2011-2013, will now be valid until the end of 2015, with significantly shortened implementation period (from 2016 until 2020). This should also significantly influence the performance of development actions envisaged in these strategies, given the fact that implementation period has been significantly shortened, and implementation of necessary measures has been postponed until 2016.

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## Annex 2 - Abbreviations

ASHE	Agency for Science and Higher Education
BERD	Business Expenditures for Research and Development
BICRO	Business Innovation Agency of Croatia
CASA	Croatian Academy of Sciences and Arts
CBS	Croatian Bureau of Statistics
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
CSF	Croatian Science Foundation
CSIPO	Croatian State Intellectual Property Office
EHEA	European Higher Education Area
ERA	European Research Area
ERA-NET	European Research Area Network
ERDF	European Regional Development Fund
ERP Fund	European Recovery Programme Fund
ESI	European Structural and Investment Funds
ESF	European Social Fund
ESFRI	European Strategy Forum on Research Infrastructures
EU	European Union
EU-28	European Union including 28 Member States
FDI	Foreign Direct Investments
FP	European Framework Programme for Research and Technology Development
FP7	Seventh 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
HEIs	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
HIT	Croatian Institute of Technology
IP	Intellectual Property
IPR	Intellectual property rights
IRCRO	Collaborative research development Programme
KONCRO	Competitiveness and technology process advancement Programme
MEC	Ministry of Entrepreneurship and Crafts

MELE	Ministry of Economy, Labour and Entrepreneurship
MLPS	Minister of Labour and Pension System
MRDEF	Ministry of Regional Development and European Funds
MoE	Ministry of Economy
MSES	Ministry of Science, Education and Sports
NCSHETD	National Council for Science, Higher Education and Technological Development
OECD	Organisation for Economic Co-operation and Development
PROs	Public Research Organisations
R&D	Research and development
RAZUM	Development of the knowledge-based companies Programme
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
RTO	Research and Technology Organisation
S&T	Science and technology
SCF	Strategic Coherence Framework 2007-2013
SDF	Strategic Development Framework 2006–2013
SF	Structural Funds
SIIF	Science and Innovation Investment Fund
SME	Small and Medium Sized Enterprise
SVEZNATE	Strategic Council for Science and Technology
TEST	Technology oriented projects Programme
UKF	Unity through Knowledge Fund
VC	Venture Capital
VNIS	National Innovation System Council of Ministry of Science, Education and Sports

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