

Supporting Entrepreneurship and Innovation in Higher Education Croatia

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Foreword

This publication presents the findings and recommendations of the HEInnovate review of the impact of higher education institutions (HEIs) on entrepreneurship and innovation in Croatia. The review assesses the strategies and practices of HEIs in Croatia in supporting entrepreneurship and innovation and the government policy context. It stresses the potential of the country to capitalise on a talented workforce and diverse higher education institutions to improve its entrepreneurship ecosystem and innovation capacity.

The review was undertaken by the OECD in partnership with the European Commission, as part of the programme of work of the OECD Local Economic and Employment Development (LEED) Committee. The review is part of the HEInnovate collaboration between the European Commission's Directorate-General for Education and Culture and the OECD Centre for Entrepreneurship, SMEs, Regions and Cities.

Investing in the innovative and entrepreneurial HEI is one of the highest return investments that we can make. Innovators and entrepreneurs are not born with all the competencies involved. Rather, the underlying attitudes, knowledge and skills are developed over time in society and through education. More needs to be done to ensure that these competencies are developed through education, and to ensure that there are the right incentives and support structures to encourage staff and students in HEIs to get involved in entrepreneurial ventures and engage with business and society.

HEInnovate is a starting point for governments and HEIs to identify areas for action. It is a guiding framework for supporting innovation and entrepreneurship in higher education. HEInnovate offers an online self-assessment tool for higher education institutions (www.heinnovate.eu), available in 24 languages, a series of country review assessments including this report on Croatia, and a Policy Learning Network that facilitates cross-country exchange and peer-learning amongst the countries participating in the country reviews.

Acknowledgements

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Sections of this report were drafted by Stephany Scotto, independent consultant, Marko Turk, Senior adviser at the Croatian National Agency for Vocational Education and Adult Education, and Marina Dabic, Professor at the University of Zagreb (Chapter 1), Giulia Ajmone Marsan, (Chapter 2), Jon File, Director Development and Consultancy, Center for Higher Education Policy Studies, University of Twente (Chapter 3), Uzi de Haan, Professor Emeritus, Technion-Israel Institute of Technology (Chapter 4), Fumi Kitagawa, Lecturer, University of Edinburg Business School, UK (Chapter 5). Jonathan Potter and Maria Sobron Bernal from the SMEs and Entrepreneurship division of the OECD Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) provided additional comments and inputs. Peter Baur, Maria Palladino, Veronica Mobilio from the Directorate General for Education and Culture of the European Commission participated in various review activities. Slavica Singer, Professor Emeritus at the J.J. Strossmayer University in Osijek, Croatia, provided valuable information, inputs and comments.

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Executive Summary

Since its independence in 1991, Croatia has moved towards a market-based economy tapping into international trade and cross-border flows of knowledge, especially after its integration to the European Union on first of July 2013. The global crisis hit Croatia harshly, slowing down economic growth for some years. Nowadays, the Croatian economy is back on positive trends; however, its growth potential is constrained by low private and public investment in higher education and research and development (R&D). These trends, among others, impinge upon the capacity of Higher Education Institutions to generate linkages with the business sector and with other key national stakeholders.

Higher education institutions (HEIs) are important actors of education, science and innovation systems and can contribute to Croatia's knowledge-based and digital economy. For example, HEIs can provide students with skills that affect their capacity to handle complexity, be proactive, work in team and be accountable for their own actions. In addition, HEIs can engage with businesses and communities to promote innovation and growth in their own ecosystems, as well as in national and international networks. Within this framework, the OECD and the European Commission have developed a holistic framework – HEInnovate – that helps national higher education systems and HEIs generate societal and economic value.

The OECD, supported by an international group of experts and peer reviewers, has engaged with national authorities to analyse the entrepreneurial and innovation agenda of HEIs, in Croatia. The findings and recommendations presented in this review are based on information gathered during study visits to selected case study HEIs, a background report produced by national experts, and a survey administered to all HEI leaders in the country. Case study HEIs were quite heterogeneous mixing large-sized HEIs (such as the University of Zagreb, which alone accounts for 44% of all students in the country), private and public institutions divided into research universities, polytechnics and professional higher education institutions.

Croatian public universities can have a peculiar governance structure compared with other international higher education systems. For instance, there are two governance arrangements in the country. Public universities can have a centralised management structure with concentrated decision-making power. In this case, the rector and the senate have full steering competencies and mandates. Alternatively, the governance of universities can be based on a so-called “non-integrated structure”. In this case, universities cluster faculties and academies that are independent legal entities and enjoy significant administrative and financial autonomy vis-à-vis the university management (i.e. the rectorate and the senate).

Key findings

Croatian HEIs have been improving their capacity to collaborate with external stakeholders to exchange knowledge and promote innovation, but there is a need for further progress.

The participation in EU programmes promoting education and innovation had a significant influence on the capacity of HEIs to assume a proactive role in their own ecosystems. For instance, the University of Dubrovnik has developed a strong link with the local tourism industry, which has been booming over the past decade. In the same vein, the University of Split has created a R&D unit, in strict collaboration with one of the most important ICT companies, in Europe. However, due to the lack of resources and incentives for professors and students, the systemic capacity of university to engage with stakeholders tend to be limited. In addition, outdated national regulation on intellectual property rights and legal obstacles to recruit staff from non-academic backgrounds represent additional challenges to HEIs' capacity to exchange knowledge and collaborate with external stakeholders.

While all case study HEIs have developed joint research projects, internships, and mentoring programmes to promote entrepreneurship education, there are still some limits in the capacity of the system to mainstream the new practices. Some HEIs have put in place innovative practices such as hackathons and business plan competitions. In the cities of Osijek, Dubrovnik and Rijeka, HEIs and local governments have collaborated to create incubators. The University of Split has created the Split City Technological Park. Most entrepreneurship courses are open to students of all faculties. However, centres for entrepreneurship – important to support and empower entrepreneurs in HEIs – are only available in the faculties of economics and in business schools. In addition, some of the HEI case studies do not mention entrepreneurship education as a priority in their mission statements.

Innovative and entrepreneurial initiatives tend to be implemented on an “ad-hoc” basis, with little institutional support or recognition. Despite the national and institutional efforts to put in place organic strategies, innovation happens because of the enthusiasm and commitment of individual faculty and staff. The limited institutional support for innovation and entrepreneurship depends also on systemic factors. Among others, the underdeveloped human resources management in HEIs, the strong autonomy at a faculty-level which goes hand in hand with the limited steering power of HEI leadership in non-integrated universities, and the sporadic funding availability for innovation and entrepreneurship.

Main recommendations

Based on the analysis, the present review provides systemic recommendations, aimed to improve the performance of the national higher education system as a whole, and granular recommendations targeting higher education institutions.

For the national government

Strengthening the linkage between strategic objectives and funding. The experience done with the Croatian Strategy for education, science and technology (2014-2020) and in particular with those objectives related to human resources reform in higher education institutions (HEI), illustrate the need to develop an efficient higher education funding system. In particular, there is a need for increasing public expenditure on higher education, which are currently at 0.7%, i.e. quite far from the EU median level of 1.4% (2019).

Improving the current regulation restricting the capacity of faculty members in public universities to engage with knowledge exchange activities with businesses, non-profit organisations, government agencies, and other higher education institutions.

Continue reforming the governance of public universities. Implement the action plan of the Croatian Strategy for education, science and technology (2014-2020) that aims to develop

a new management model and a new method of appointing Rectors and Deans for higher education institutions to mitigate the problems associated with independent faculties and improve coordination. In the current system, innovation and entrepreneurship strategies and their implementation are left to deans rather than to the Rector's team. Therefore, in non-integrated universities, there are many individual strategies promoting the entrepreneurial and innovation agenda, with no central coordinating mechanisms.

For higher education institutions

- Mainstreaming entrepreneurship education. HEIs can contribute to improve access to entrepreneurship learning opportunities in all faculties and campuses. For instance, HEIs could strengthen entrepreneurship education by developing courses across faculties and/or general courses with specific faculty-related modules targeting the development of entrepreneurial mind-sets. In addition, HEIs, including research universities and polytechnics, could create centres for entrepreneurship and innovation to support students and facilitate interaction between HEI and the business community. These centres could gather intelligence to respond to the needs and demands of businesses, partners and citizens and local public organizations thus developing a dynamic knowledge exchange ecosystem and building sustainable relationships with different partners.
- Developing appropriate structures and institutions for knowledge exchange activities. HEIs should be able to consider knowledge exchange activities as part of their core institutional strategies. On the one hand, TTOs, student Career Centres, SME support centres should be able to plan knowledge exchange activities. On the other hand, coordination at the central level should frame activities within a common and coherent institutional strategy. Particularly in large and non/semi-integrated HEIs, the central level should also organise strategic resource acquisition planning and resource implementation, to avoid resource fragmentation.
- Giving institutional visibility to knowledge exchange and collaboration. For instance, HEIs could recognise knowledge exchange activities as part of their academic reward and promotion criteria. In addition, HEIs could link objectives regarding knowledge exchange and collaboration with their education and research missions.

Chapter 1. Higher Education, Entrepreneurship and Innovation in Croatia

This chapter starts with an overview of Croatia's innovation and entrepreneurial capacity and goes through some key indicators that allow for a comparison with neighbouring countries in the European Union. It also assesses the country's innovation capacity by exploring ties between higher education institutions and the business sector. In addition, the chapter also presents the higher education system in Croatia. It provides an overview of the main trends observed in the tertiary education over the past ten years. Furthermore, it presents the type of higher education institutions, the funding arrangements as well as the policy framework that regulates the national system.

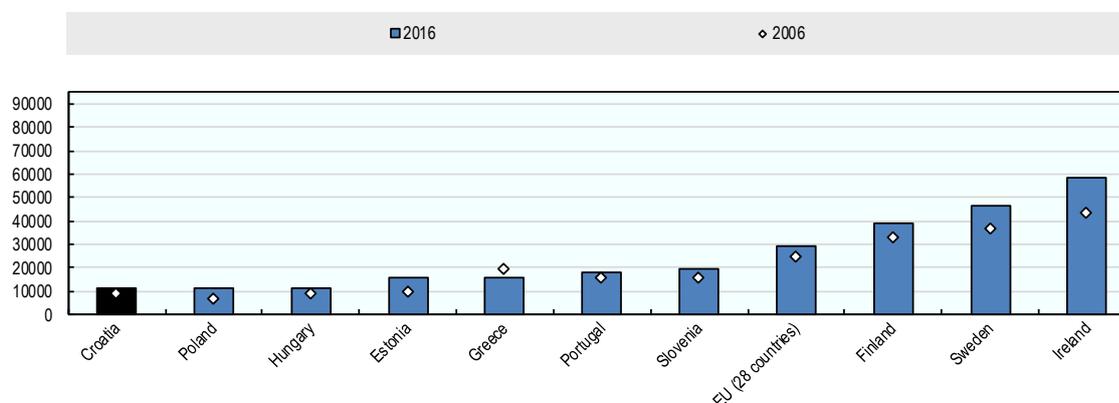
Macro-economic and innovation trends in Croatia since its independence

Since its independence in 1991, Croatia underwent a period of institutional made much progress since, moving successfully to a market-based economy tapping into international trade and cross-border flows of knowledge (OECD 2014). This process culminated into the Croatian accession to the European Union on the 1st of July 2013, which opened up new opportunities for the development of national and international knowledge and innovation networks.

The global financial crisis had an important impact on Croatia's economy, as and economic transformation. The country has in many OECD and European countries. Croatia's economic growth slowed and GDP per capita declined during the 2009-2014 period. However, economic growth has resumed since the year 2015 and real GDP growth has been registered. Moreover GDP per capita has expanded in 2017 overreaching its 2008 value (Figure 1.1). Some of the main factors that explain the country's recent economic growth are domestic demand and private consumption. In addition, the increase of exports goods and tourism (Box 1.1) have contributed to the economic recovery (European Commission 2018). Nonetheless the vigorous economic growth, Croatia's GDP per capita lags behind the EU28 average.

In general, the macroeconomic outlook is positive for the country. According to EU forecasts, economic growth is likely to remain solid and achieve, in 2019, its pre-recession levels (European Commission 2018). This steady economic growth may be boosted by favourable external conditions, such as increasing demand of the country's exports, expansion of investment rates forecast for 2018 and 2019, as well as a steady increase of private consumption. Despite Croatia's decline in trade balance, the country's has managed to generate surpluses of its current account, reducing its external burden. In addition, inflation has slightly increased in 2017 (1.3%) and it is expected to continue this growing path due to the raise of wages and energy prices. Moreover, due to favourable economic conditions that have improved revenues, the country's government deficit has been strongly reduced, from 3.3% of GDP in 2015 to 0.9% in 2016. And it is expected to continue this trend. As a result of positive forecasts regarding economic activity and the reduction of government deficit, Croatia's debt ratio is presumed to be reduced in the near future (European Commission 2018).

Figure 1.1. Gross domestic product per capita



Current prices, Euros (2007 and 2017, or latest available data)

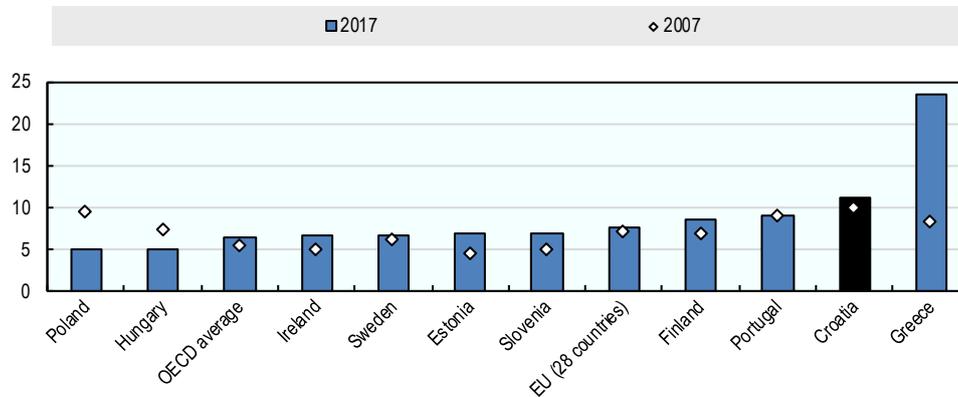
Source: Eurostat

Although economic growth has recovered, the labour market still presents fragile conditions. Both the active population and the number of employed people have decreased, and are below the EU average. Negative migration flows, especially of young skilled people, and an ageing population explain these negative trends (OECD 2018a, European Commission 2018). Furthermore, in 2017 the unemployment rate reached 11.1%, above the country's 2007 rate of 9.9%, evidencing difficulties to return to the pre-crisis labour market path. Unemployment has however decreased since the financial crisis: it was 17.4% in 2013. However, in 2017 it remained above the EU28 average of 7.6% and OECD average of 5.8%, as well as of neighbour countries such as Hungary (4.2%) and Slovenia (6.6%) (Figure 1.2).

According to recent forecasts, the unemployment rate is expected to continue its declining path. Despite this positive trend, youth unemployment is still high. Regarding employment contracts, permanent ones have increased in 2017, although the share of temporary ones is still significant in the labour market. Regardless of the reduction of unemployment rate in the country, the hazard of poverty and social exclusion is high –especially among low skilled people–, even though it has declined in the past year (European Commission 2018).

Figure 1.2. Total unemployment rate

as a percentage of active population (2007 and 2017, or latest available data)



Source: Eurostat for non OECD member countries and OECD stat for member countries.

Education and skills : trends and issues

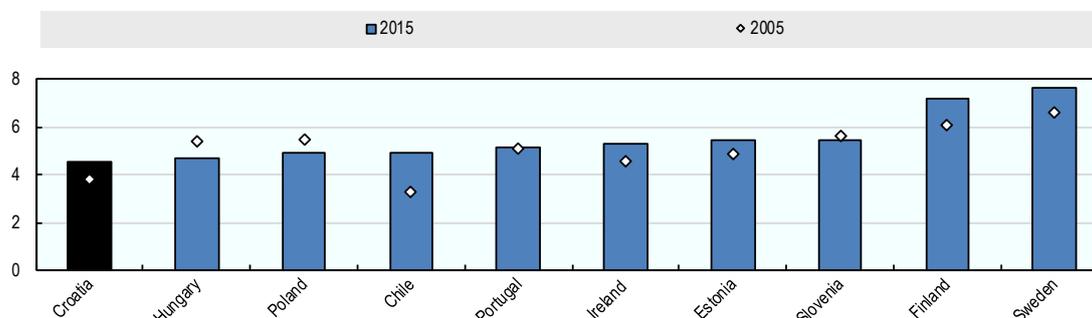
Skilled human resources are a key asset in modern knowledge based-economies to promote social and economic development. In this regard, higher education institutions (HEI) play an essential role in providing the skills necessary to enable innovation knowledge-dissemination. There are different set of indicators that provide a broad approach to a country's performance in education and its human capital skills, these include for example the government expenditure on education and specifically in tertiary education, graduated in tertiary education and OECD's Programme for International Student Assessment (PISA) results¹ (OECD, 2015).

In 2013, Croatia's expenditure on education represented 4.6% of its GDP, an important increase from its 2004 investment which rose to 3.8%. Despite this considerable boost, the country's expenditure lags behind neighbouring Eastern European countries such as Slovenia, Hungary and Estonia (Figure 1.3). However, in Croatia the share devoted to higher education has increased compared to its pre-crisis expenditure. It remains however below the European median.

¹ PISA is an international survey that has the objective to evaluate education systems by assessing the skills and knowledge of 15 year-olds. For more information regarding the programme visit: <http://www.oecd.org/pisa>

Figure 1.3. Government expenditure on education as a % of GDP

(2005 and 2014, or closest available year)



Note: Data for Chile 2014 is from 2015

Source: Unesco statistics

The quality of education is an essential component to address the performance of human resources in the labour market. In this regard, OECD PISA programme seeks to evaluate education systems through the examination of skills and knowledge of 15 year old students. When taking in consideration the 2015 OECD PISA survey (OECD 2015), Croatian students scored below the OECD average, innovation intensive countries (Sweden, Norway) and Easter European ones (Slovenia and Estonia, for instance) in all three areas: reading, mathematics and science. The scores shown in Table 1.1 evidence the gaps and achievement challenges that the country's secondary education performance features.

Nonetheless, when comparing Croatia's results of the 2012 OECD PISA survey with the 2015 ones, modest improvements are observed. The country's reading scores increased slightly from 485 to 487. However, math scores have deteriorated from 471 to 464, as well as science skills (from 491 to 475). Overall, in all three PISA surveys (2009, 2012 and 2015) the country has performed under the OECD average in all three areas (reading, math and science).

Table 1.1 PISA results, 2015

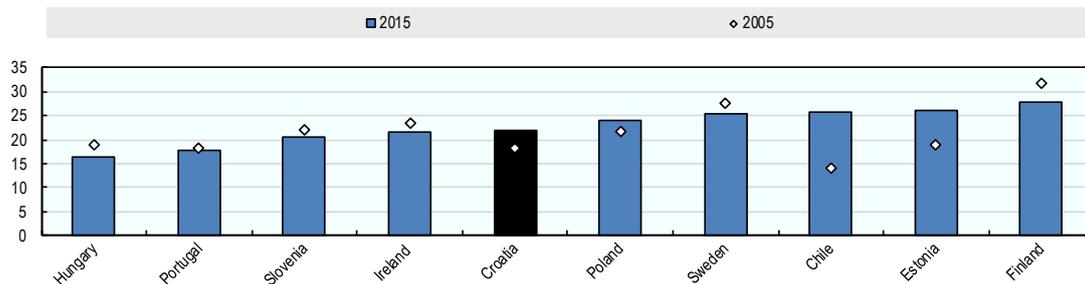
| Country mean score, 2015 | | | | | |
|--------------------------|------------|------------------------------|------------|--------------------------|------------|
| Mean reading performance | | Mean mathematics performance | | Mean science performance | |
| Turkey | 428 | Turkey | 420 | Turkey | 425 |
| Bulgaria | 432 | Bulgaria | 441 | Romania | 435 |
| Romania | 434 | Romania | 444 | Bulgaria | 446 |
| Slovak Republic | 453 | Greece | 454 | Greece | 455 |
| Greece | 467 | Croatia | 464 | Slovak Republic | 461 |
| Hungary | 470 | Slovak Republic | 475 | Croatia | 475 |
| Italy | 485 | Hungary | 477 | Hungary | 477 |
| Austria | 485 | Latvia | 482 | Italy | 481 |
| Croatia | 487 | Spain | 486 | Latvia | 490 |
| Czech Republic | 487 | Italy | 490 | Spain | 493 |
| Latvia | 488 | OECD average | 490 | Czech Republic | 493 |
| OECD average | 493 | Portugal | 492 | OECD average | 493 |
| Spain | 496 | Czech Republic | 492 | Sweden | 493 |
| United Kingdom | 498 | United Kingdom | 492 | France | 495 |

| | | | | | |
|-------------|-----|-------------|-----|----------------|-----|
| Portugal | 498 | France | 493 | Austria | 495 |
| France | 499 | Sweden | 494 | Norway | 498 |
| Sweden | 500 | Austria | 497 | Portugal | 501 |
| Netherlands | 503 | Norway | 502 | Poland | 501 |
| Slovenia | 505 | Ireland | 504 | Ireland | 503 |
| Poland | 506 | Poland | 504 | Netherlands | 509 |
| Germany | 509 | Germany | 506 | Germany | 509 |
| Norway | 513 | Slovenia | 510 | United Kingdom | 509 |
| Estonia | 519 | Finland | 511 | Slovenia | 513 |
| Ireland | 521 | Netherlands | 512 | Finland | 531 |
| Finland | 526 | Estonia | 520 | Estonia | 534 |

Source: OECD PISA 2015 Database

The number of graduates in tertiary education provides an extensive indicator of a country’s capacity to accumulate human capital. In 2016, Croatia had 68 graduates in tertiary education (levels 5-8) per 1000 population (Figure 1.4). However, enrolment in tertiary education has declined in comparison to the academic year of 2013-2014. It is heavily concentrated in public institutions and most students in tertiary education are enrolled in bachelor and master degrees, while a scarce 2% of the student population are enrolled in doctoral training (OECD 2018a).

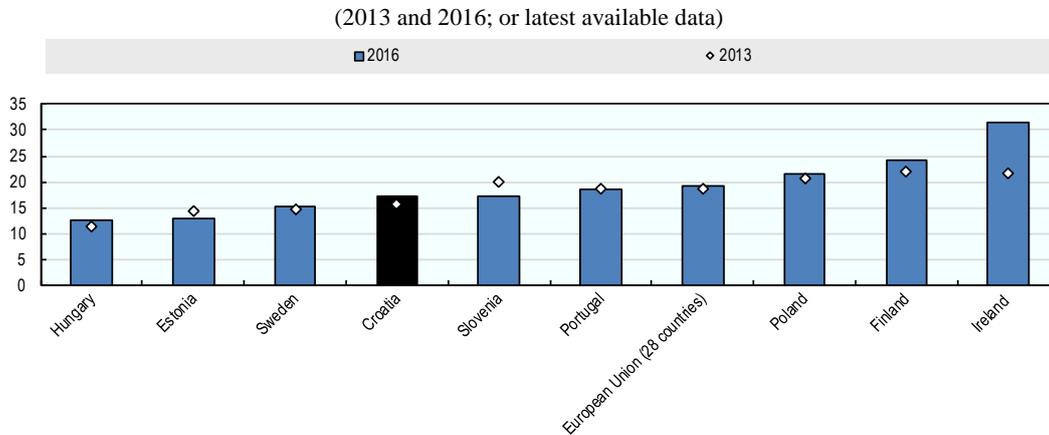
Figure 1.4. Graduates in tertiary education (levels 5-8) per 1000 of population (2016)



Source: Eurostat

Graduates in science, technology, engineering and mathematics (STEM) fields are an important indicator of the supply of science and technology personnel in a country. Therefore they are directly linked to the technological and industrial capacities of an economy. Croatia has increased its graduates in tertiary education per 1000 population aged 20-29 in STEM related fields, from 15.5 to 17.1 in the 2013-2016 period (Figure 1.5). Despite this increase the country still falls behind the EU28 average of 19.1 graduates (2015). There are many examples of universities promoting STEM careers among students in many universities in Croatia as detailed in the next chapters of this report.

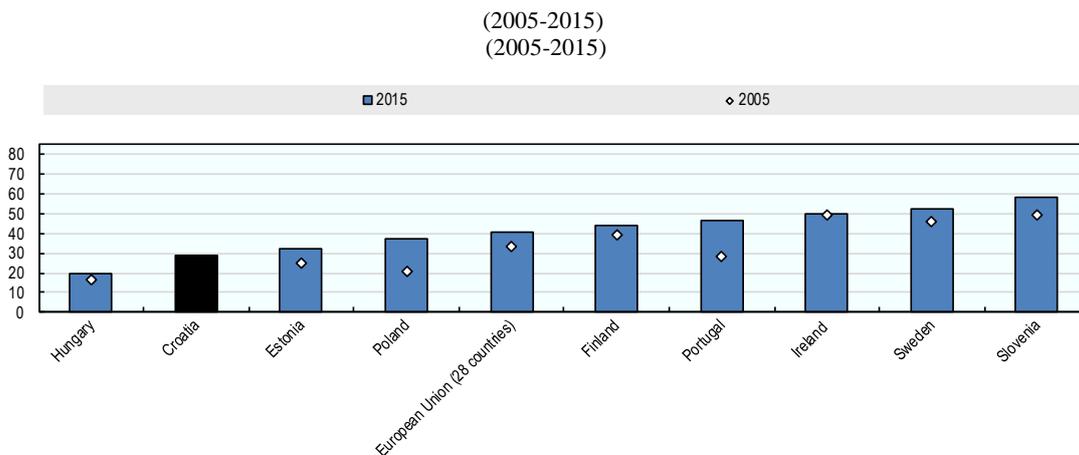
Figure 1.5. Graduates in tertiary education, in science, math, computing, engineering, manufacturing, construction per 1000 of population aged 20-29



Note: data for Portugal and EU (28 countries) 2016 is from 2015; data for Poland 2013 is from 2014
 Source: Eurostat

Besides tertiary education, lifelong learning also provides a significant source of knowledge creation, offering considerable improvements of peoples’ skills and competences. Croatia’s participation in Continuing Vocational Training (CVT) courses as a percentage of persons employed in all enterprises is of 29%, below the EU28 average of 41% and behind Eastern European countries such as Estonia (32%) and Slovenia (58%) as well as northern countries as Finland (44%) and Sweden (52%) (Figure 6). In order to improve the country’s capacities in this area, Croatia has engaged in fostering science, technology and innovation and education performance in the country. Lifelong learning has become one of the main areas included in the country’s Strategy for Education, Science and Technology 2014-2020 following the Horizon 2020 framework programme for research and innovation (OECD 2018b).

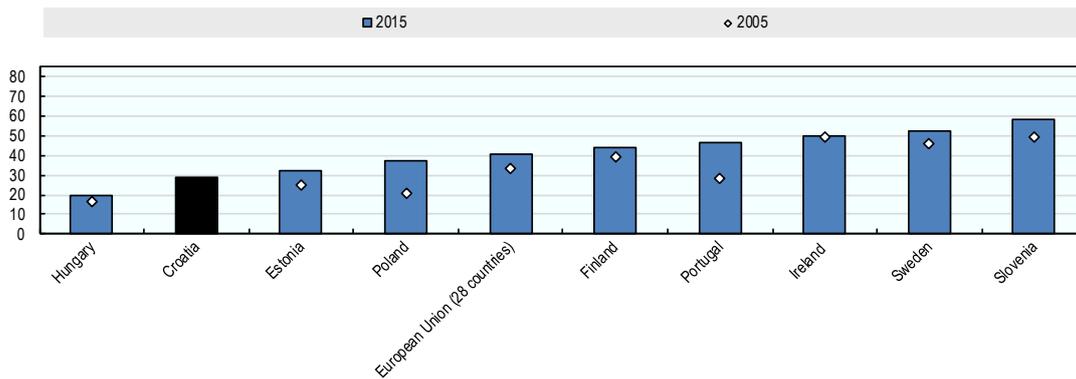
Figure 1.6. Participants in CVT courses as a percentage of persons employed in all enterprises



Note: no available data for Croatia 2005
 Source: Eurostat

When considering participants in CVT courses by sex in Croatia, females emerge as the main participants, unlike the EU28 average, Ireland, Sweden, Hungary and Poland, where the majority of people taking CVT courses in enterprises are men (Figure 7).

Figure 1.7. Participants in CVT courses by gender
as a % of persons employed in all enterprises (2015)

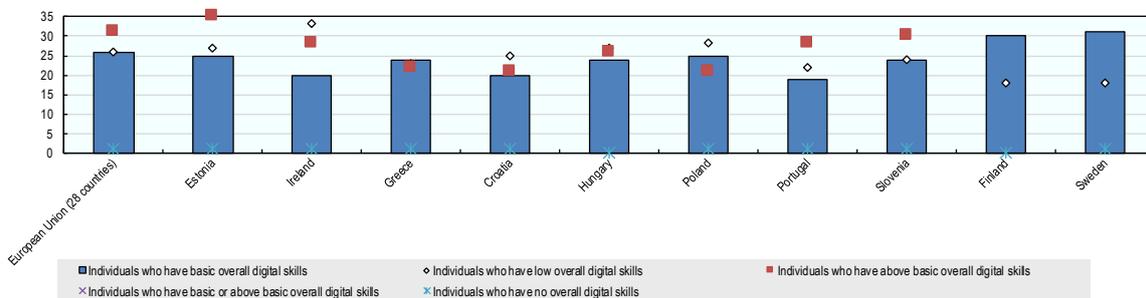


Source: Eurostat

In innovation intensive countries, learning goes beyond traditional education systems. Information and communication technologies (ICTs) skills and competences play an important role in the information society both at work as at home, and are key elements regarding employment prospects and firm growth, especially in small and medium size enterprises (SMEs). In Croatia, 25% of individuals have low digital skills, below the EU28 average of 26% and Ireland (33%). However, individuals with basic or above basic digital skills in Croatia rises to 41%, below the EU28 average of 57%, neighbour countries (Slovenia for instance) and digital driven economies such as Finland (76%) (Figure 8). When taking into consideration individuals with no digital skills the country presents the same percentage as the EU28 average: 1%.

Figure 1.8. . Individuals' level of digital skills

2017, % of individuals



Source: Eurostat

Entrepreneurial behaviour and attitude²

Entrepreneurial capacity of Croatia, as measured by GEM data (Table 1.2), can be described as slowly increasing after a sharp decline in 2008. This increase of entrepreneurial activity (measured by the TEA index – Total entrepreneurial activity, representing number of new businesses, up to 42 months, among the adult population) brought Croatia in 2017 to the EU average (8.9 % in Croatia vs. 8.3% in EU). This satisfactory intensity of early entrepreneurial activity is in contrast with a not so satisfactory motivational index (representing the ratio of persons started a business out of recognized opportunity and those who did it out of necessity). In Croatia, this ratio is 1.8 while the average of 18 EU countries participated in GEM 2017 survey is 5.0 (with the highest motivational index of 11.6 in the Netherlands).

Other features of entrepreneurial behaviour in Croatia are:

- high intentions to start a business are mostly result of lack of other working options, but those people who enter entrepreneurial activity out of necessity, usually lack of capabilities to recognize opportunities, to manage own business and bring it to a growing phase;
- lack of businesses with growth potential (measured by newness of products, internationalization, job creation);
- low competitiveness of Croatian businesses (due to lack of new products, despite of quite satisfactory technology readiness), what prevents more intensive export orientation.

The features of entrepreneurial behaviour in Croatia, as in most countries, are closely linked to the context in which entrepreneurial activity is performed. GEM evaluates the entrepreneurial environment by identifying different components (access to money, government policies and programs, education, R&D, market openness, physical infrastructure, professional support infrastructure, cultural value). In all years of Croatia's participation in GEM (from 2002 to 2017), the least valued components are: government policies toward regulatory framework, education for entrepreneurial competences and efficiency of R&D.

The weak regulatory framework has not been signalled to the government of Croatia only by GEM survey, but confirmed as well by findings from the World Economic Forum (Global Competitiveness Report), the World Bank (Doing Business) and the Croatian business associations, for years. In particular, according to the World Bank Group Flagship Report Doing Business 2018, in terms of Ease of doing business in 2017, Croatia was ranked 51st, which represented a significant decline in comparison to the years 2016 (rank 43) and 2015 (rank 40). The same report states that starting business in Croatia is relatively difficult (rank 87) as well as dealing with construction permits (rank 126), which was especially emphasised due to increase of administrative fees for building and occupancy permits.

² This section is largely based on Singer, S. et al. Što čini Hrvatsku (ne)poduzetničkom zemljom? GEM Hrvatska 2017, CEPOR, Zagreb, 2018 <http://www.cepor.hr/wp-content/uploads/2018/05/GEM-2017-za-web-FINAL.pdf>

Table 1.2. Entrepreneurial Behaviour and Attitude – the GEM Survey

| GEM Variable | Croatia 2017 | Global average |
|--|-----------------|-------------------|
| Self-perceptions | | |
| Perceived opportunity rate (% of 18-64 population - individuals involved in any stage of entrepreneurial activity excluded – who see good opportunities to start a firm in the area they live) | 33.6 | 43.4 |
| Perceived Capability Rate (% of 18-64 population - individuals involved in any stage of entrepreneurial activity excluded – who believe they have the required skills and knowledge to start a business) | 50.8 | 48.8 |
| Fear of Failure Rate (% of 18-64 population - individuals involved in any stage of entrepreneurial activity excluded – who indicate that fear of failure would prevent them from setting up a business) | 26.6 | 37.0 |
| Entrepreneurial Intentions Rate (% of 18-64 population - individuals involved in any stage of entrepreneurial activity excluded – who are latent entrepreneurs and who intend to start a business within 3 years) | 17.5 | 26.3 |
| Activity | | |
| Total Early Stage Entrepreneurial Activity (% of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business) | 8.9 | 12.5 |
| Established Business Ownership Rate (% of 18-64 population who are currently an owner-manager of an established business, i.e. owning and managing a running business that has paid salaries, wages, or any other payments to the owners for more than 42 months) | 4.4 | 8.5 |
| Entrepreneurial Employee Activity Rate (Rate of involvement of employees in entrepreneurial activities, such as developing or launching new goods or services, or setting up a new business unit, a new establishment or subsidiary) | 4.8 | 3.3 |
| Motivations | | |
| Motivation Index (% of those involved in TEA that are improvement-driven opportunity motivated, divided by the % of TEA that is necessity motivated) | 1.2 | 3.4 |
| Impact | | |
| High Job Creation Expectation Rate (% of those involved in TEA who expect to create 6 or more jobs in 5 years) | 30.4 | 19.7 |
| Innovation Rate (% of those involved in TEA who indicate that their product or service is new to at least some customers and that few/no business offer the same product) | 19.9 | 26.5 |
| Business Service Sector Rate (% of those involved in TEA in the ‘Business Service’ sector – Information and Communication, Financial Intermediation and | 21.7 | 17.4 |

| <i>Real Estate, Professional Services or Administrative Services, as defined by the ISIC 4.0 Business Type Codebook)</i> | | |
|--|------|------|
| Societal Values | | |
| High Status to Successful Entrepreneurs Rate <i>(% of 18-64 population who agree with the statement that in their country, successful entrepreneurs receive high status)</i> | 47.7 | 68.5 |
| Entrepreneurship as a Good Career Choice Rate <i>(% of 18-63 population who agree with the statement that in their country, successful entrepreneurs receive high status)</i> | 62.2 | 61.6 |

Source: Global Entrepreneurship Monitor data 2017

Lack of education for entrepreneurial competences, especially on primary and secondary level, was identified as a weakness by GEM analysis. In this respect HEIs in Croatia have a role to play by being more proactive in building individual, institutional and national entrepreneurial capacity will not be achieved.

Innovation performance

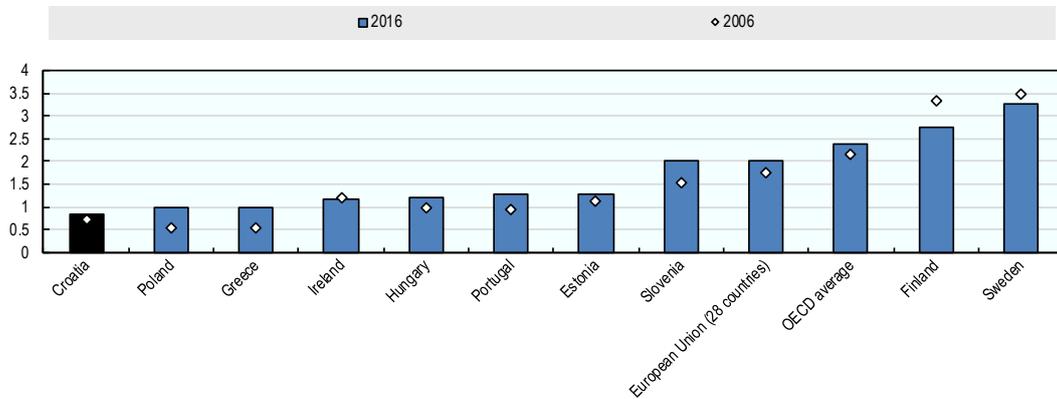
According to the European Innovation Scoreboard 2017, Croatia is in the category of Moderate Innovator countries, which includes European countries with the performance of the innovation system ranges between 50% and 90% of the EU average. This group encompasses countries such as Italy, Spain, Slovakia, Czech Republic, Hungary, etc. Performance of the Croatian Innovation system has declined 1.4% in 2016 relative to the EU as it amounted to 54.7% of the EU average, which is on lower end of the spectrum of Moderate innovators and close to the border to Modest Innovators (such as Romania and Bulgaria). Strengths of the Croatian innovation systems are considered to be Firm investments, Human resources, and Employment impacts. However relative weaknesses are found in intellectual assets, Attractive research system and innovators (European Innovation Scoreboard, 2017).

Recent OECD and EU report (OECD 2014, Racic et al. 2016) suggest how boosting innovation in Croatia is an important element of any strategy for sustainable development and economic growth and rising living standards. Higher education institutions as key actors of any education, science and innovation system are crucial in this respect to provide skilled people to public and private organisations that can become the innovation engines of the country.

There are several indicators that proxy innovation inputs and outputs, providing relevant information regarding innovation performance. For instance, gross domestic expenditure on research and development (GERD) as a percentage of GDP is an important indicator which captures the financial resources committed to research and development (R&D) in a given country. In this regard, Croatia has slightly increased its expenditure in the 2006-2016 period, from 0.74% of GDP to 0.85%. However, the country has not been able to reduce the gap with EU and OECD countries. Croatia's expenditure on R&D is well below the 2016 EU and OECD average of 2% and 2.3%, respectively (Figure 1.9).

Figure 1.9. GERD as a % of GDP

(2006 and 2016, or latest available data)

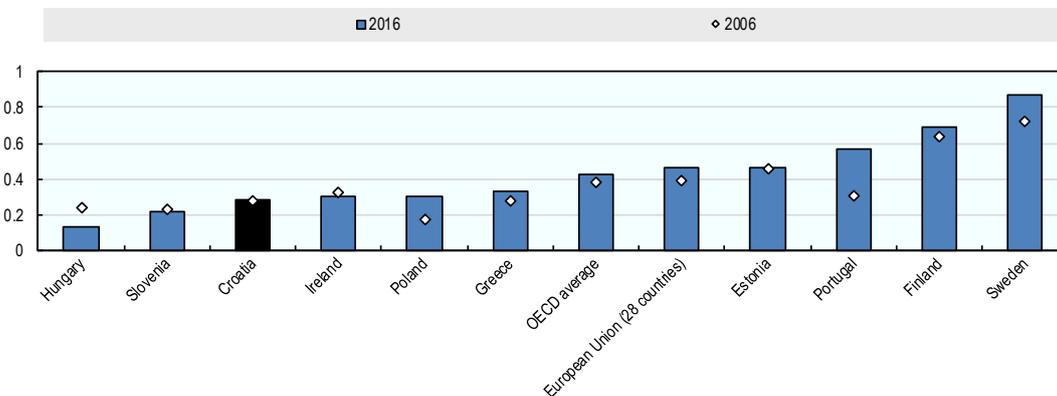


Source: Eurostat and OECD MSTI database for OECD countries

Similarly, higher education expenditure on R&D (HERD) as a percentage of GDP in Croatia also shows the country's underinvestment in this area. The expenditure has remained mainly unchanged in the 2006-2016 period (0.27% and 0.28%), substantially below the OECD (0.41%) and EU28 average (0.47%), although well above countries such as Hungary (0.13%) and Slovenia (0.22%) in 2016 (Figure 1.10).

Figure 1.10. HERD as a percentage of GDP

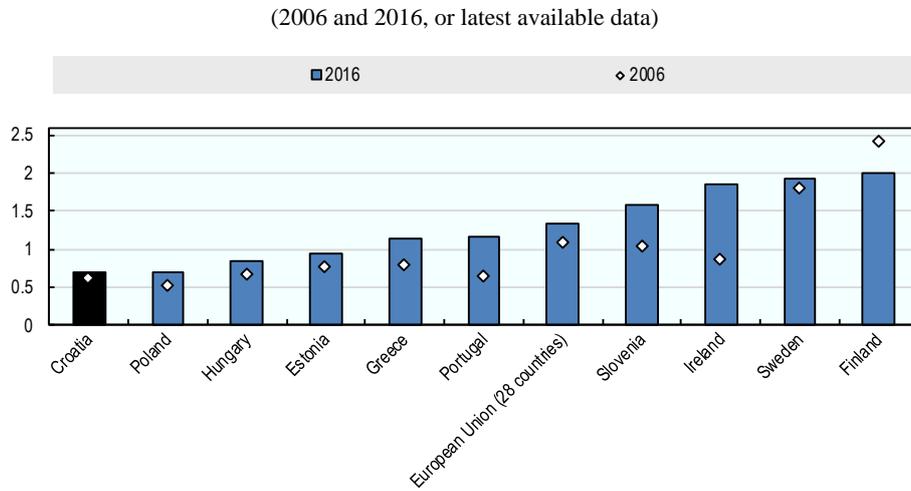
(2006 and 2016, or latest available data)



Source: Eurostat and OECD MSTI database for OECD countries

In addition to the low investment in R&D, Croatia also presents weaknesses regarding R&D personnel. The supply of human resources on R&D activities in the country slightly increased in 2016 (0.7%) in comparison to 2006 (0.6%), however it still remains well below the EU 28 average of 1.3% in 2016 (Figure 1.11).

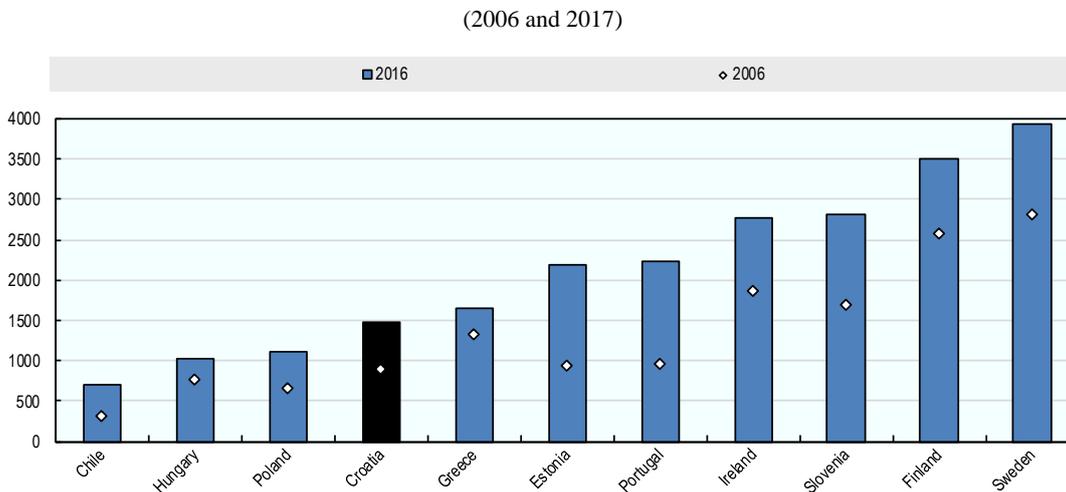
Figure 1.11. Total R&D personnel Full-Time Equivalent (FTE) as a percentage of total employment



Source: Eurostat

Croatia’s intensity of scientific output measured through counts of scientific publications per million population, has increased substantially between the years 2006 and 2017 (Figure 1.12). Regardless, the country’s publications remain beneath highly innovation intensive OECD countries as Israel, Finland and Sweden. Croatia presents a better intensity of scientific output than OECD countries such as Chile, Hungary and Poland.

Figure 1.12. Scientific publications per million population



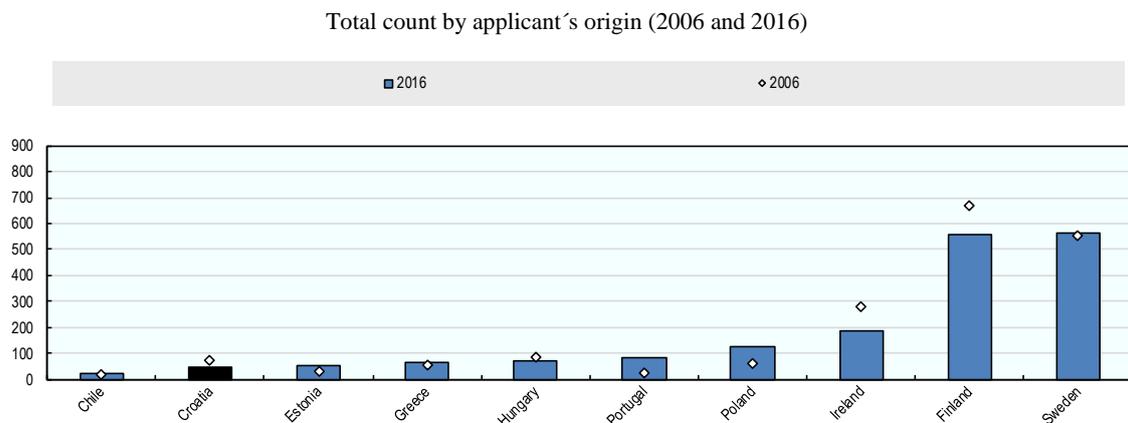
Source: Scimago Research Group (2018), scimago website <http://www.scimagojr.com>, World Bank

Croatia’s scientific publications are concentrated in fields such as medicine, engineering, social sciences, physics and astronomy, agricultural and biological sciences and computer science. Even though social sciences and art and humanities are important scientific fields, Croatia’s top scientific production is concentrated primarily on basic and applied sciences. The country’s publication production has increased in all scientific fields for the 2007-2017 period.

Patents are a frequently used indicator of innovation output since these reveal the creation of economically useful innovations (OECD 2018b). However patents tend to only capture technological and R&D based innovations. Croatia's resident's patent applications per million population (by origin)³ is weak in comparison to the selected countries in Figure 1.14. The country has decreased its applications in the 2006-2016 period from 71 to 45.

Innovation output indicators such as intensity of scientific output and patent applications are often related to R&D technological innovation. The low performance of Croatia may be a consequence of the weak investment and demand of R&D activities and personnel, especially in the business sector.

Figure 1.13. Resident patent applications per million population (by origin)



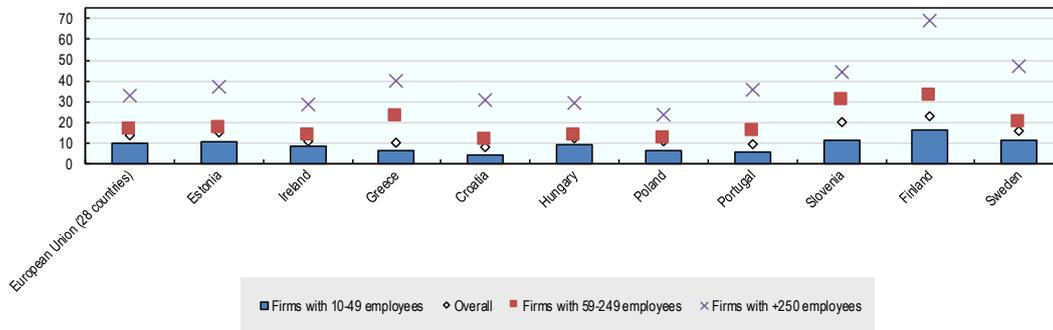
Source: WIPO

In Croatia, as on average in the EU and in most OECD countries, larger firms cooperate in a larger extend with universities. For instance, only 4% of small Croatian firms cooperated with universities or HEI, while 12% of medium size firms did, versus 31% of large ones. In general terms, this is a common trend observed both in developed as in developing countries, as small and medium size enterprises (SMEs) often lack the means to cooperate and generate linkages with HEI and universities and, in general, engage less in innovation activities. On average in EU28, 10% of small firms cooperated with universities and HEI, while 17% of mediums and 33% of large firms did (Figure 1.14).

³ Total count by applicant's origin

Figure 1.14. Percentage of enterprises co-operating with universities or other higher education institutions

(NACE Rev. 2), 2014

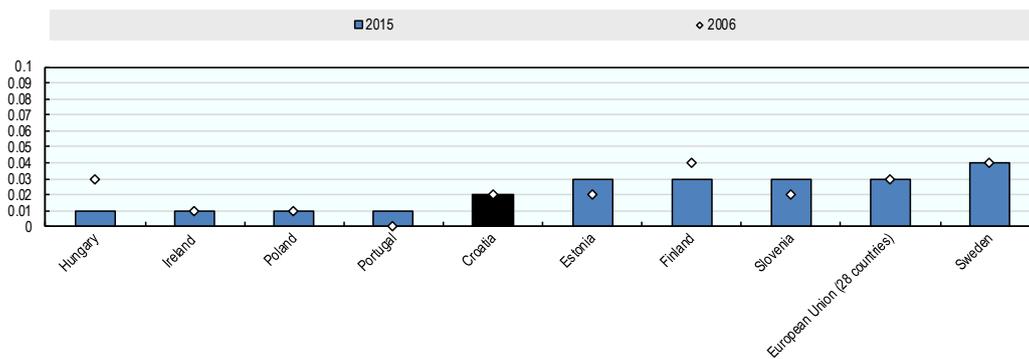


Note: Product and/or process innovative enterprises, regardless of organisational or marketing innovation (including enterprises with abandoned/suspended or on-going innovation activities)
Source: Community Innovation Survey 2014 (CIS), Eurostat

The weak linkages between HEI and the business sector in Croatia are an important obstacle that hinders innovation. A way to proxy this type of linkages is the amount of R&D performed by the higher education sector financed by the business sector. In Croatia, it has remained unchanged in the 2006-2016 period and is low (0.02), below EU28 average (0.03) (Figure 1.15).

Figure 1.15. HERD financed by business enterprise sector

As a percentage of GDP (2006 and 2015)

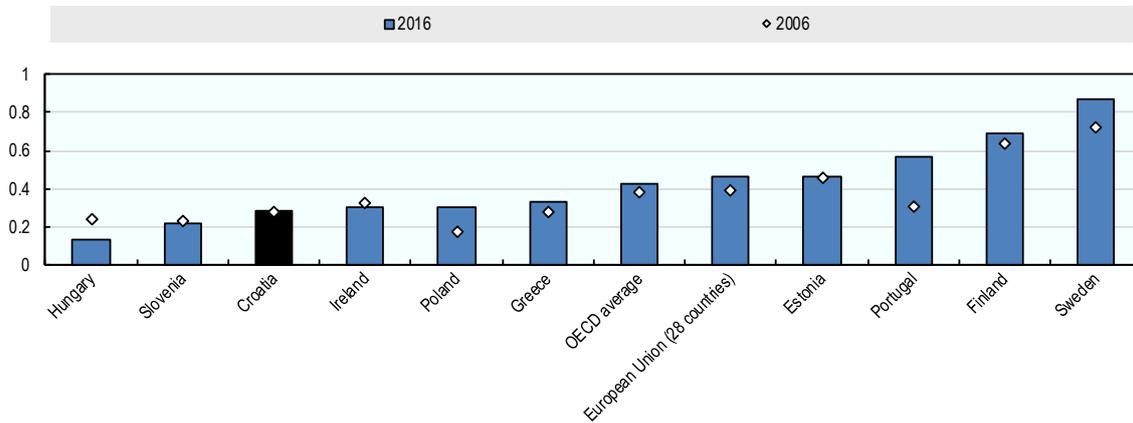


Source: Eurostat

Croatia participates in international science and innovation programmes and the country’s ability to attract these funds can be considered an indication of Croatia’s science and innovation performance at the international level. The European Commission, through its Science and Innovation Programmes fosters investments in R&D and innovation, stimulating a knowledge-based economy. Croatia’s success rate of applicants to FP7 calls was of 18.5% in 2013, above Slovenia (14.7%), Portugal (15.1%), Greece (15.3%), Poland

(16.4%) and Finland (16.7%), although below Sweden (20.8%) and Ireland (21%). The total success rate of Croatia is of 16.9% above Greece and Slovenia, but below Portugal, Poland, Hungary, Estonia, Finland, Ireland and Sweden (Figure 1.17).

Figure 1.16. EU success rated for FP7 calls concluded in 2007-2013, by country



Source: (European Commission 2015)

In addition, Croatia also participates and benefits from the latest European Union’s research and innovation framework programme, Horizon 2020. According to the interim evaluation of this programme (European Commission 2017), the Horizon 2020 contribution normalised per inhabitant and per researcher FTE in Croatia has been below the EU 28 average. Nonetheless, when considering the contribution per million Euros spend on R&D Croatia has benefited in a greater extent than the EU 28 average (see Table 1.3).

Table 1.3. Horizon 2020 contribution normalised per inhabitant, researchers FTE and R&D investment, selected countries

| Country | H2020 contribution (EUR million) | Per inhabitant | Per researcher FTE | Per EU million spend on R&D |
|---------|----------------------------------|----------------|--------------------|-----------------------------|
| Croatia | 32 | 8 | 5 042 | 85 644 |
| Estonia | 66 | 50 | 15 767 | 217 990 |
| EU 28 | 18 953 | 37 | 10 426 | 63 429 |
| Finland | 430 | 78 | 11 470 | 70 879 |
| Greece | 435 | 40 | 12 396 | 258 158 |
| Hungary | 109 | 11 | 4 298 | 72 008 |
| Ireland | 356 | 75 | 16 610 | 121 962 |
| Poland | 185 | 5 | 1 908 | 42 743 |

| | | | | |
|----------|-----|----|--------|---------|
| Portugal | 343 | 33 | 8 663 | 149 794 |
| Slovenia | 109 | 53 | 13 848 | 128 243 |
| Sweden | 704 | 71 | 10 249 | 48 267 |

Source: European Commission 2017

The higher education system in Croatia

The Croatian higher education system is regulated by the Act on Scientific Activity and Higher Education (OG 123/03, 198/03, 105/04, 174/04, 02/07, 46/07, 45/09, 63/11, 94/13, 139/13, 101/14, 60/15, 131/17). The competent ministry on this area is the Ministry of Science and Education (MSE). The Act went through numerous amendments, as the system underwent a process of reform, due to signing of the Bologna Declaration in 2001, which has been actively implemented since 2004. The first step of the reform, in 2005, was to introduce modifications in the study programmes in line with the Bologna principles, when a 3-cycle study model and ECTS credit system were introduced. In the period 2005 – 2009 postgraduate programmes also went through a process of restructuring.

Types of Higher Education Institutions in Croatia

Higher Education Institutions in Croatia include: universities, polytechnics (sometimes referred to in the English translation as university of applied sciences) and schools of professional higher education (ASHE 2018, Agency of Science and Higher Education, Higher Education in the Republic of Croatia). These types of HEIs can be both public and private.

According to data provided by the Ministry of Science and Education⁴ there are approximately 135 HEIs active in Croatia, which include 11 universities (8 public and 3 private) encompassing faculties, academies, university departments and university centres, 26 schools of professional higher education (3 public, 23 private) and 16 polytechnics (11 public and 5 private), (MSE, 2018).

There are 8 public universities in Croatia, which constitute the core of the Croatian higher education system: J. J. Strossmayer University of Osijek (UNIOS), Juraj Dobrila University of Pula (UNIPU), University North in Koprivnica (UNIN), University of Dubrovnik (UNIDU), University of Rijeka (UNIRI), University of Split (UNIST), University of Zadar (UNIZD) and University of Zagreb (UNIZG). Two private universities are also situated in Zagreb and include: the Catholic University of Croatia, Libertas International University.

University study programmes qualify students to work in science and higher education, the private and public sector as well as, and to develop and apply scientific and professional knowledge. Professional study programmes (provided by polytechnics and schools of professional higher education) provide the students with the knowledge and skills required to work in applied professions, and direct integration into the working process. According to the Act on Scientific Activity and Higher Education the difference between polytechnics and schools of professional higher education is that polytechnics are institutions of professional higher education which deliver at least three study programmes from at least three scientific fields, while schools of professional higher education offer a limited

⁴ <https://mozvag.srce.hr/preglednik/pregled/en/tipvu/odabir.html>

number. In Croatia there is a clear majority of university study programmes (1162) compared to professional study programmes (255).

As in most OECD and EU countries, university programmes consist of three levels: undergraduate, graduate and postgraduate (further divided into specialist and doctoral studies). The duration of undergraduate programmes ranges between three (180 ECTS) and four years (240 ECTS), after the completion of which, the student is awarded the title of Bachelor (*bacc.*) with reference to specialisation. Graduate programmes usually last between one and two years (60-120 ECTS), and after its completion, the student is awarded an academic title of Master with reference of specialisation (*.mag*). After completing the postgraduate specialist studies, which last between a year and two years, students are awarded the title of university specialist (*univ. spec*) with reference to a specialisation. The duration of doctoral studies amounts to three years. Upon its completion the academic title of Doctor of Science/Arts is awarded (*dr.sc.* or *dr. art.*). In addition to the study programmes described above, integrated study programmes (such as law, medical studies, primary teacher study programmes) combine bachelor and master degrees, they typically last 5 years and they account for 300 ECTS.

Professional study programmes include short-cycle professional study programmes (of the duration of 2-2.5 years and corresponding to 120-150 ECTS), undergraduate professional study programmes (duration of 3 years, corresponding to 180-240 ECTS, providing the title of professional bachelor), specialist graduate study programmes (of the duration of 1 or 2 years, 60-1200 ECTS and providing the title of professional specialist in a specific field).

In Croatia, all legal entities performing scientific activity pursuant to the Act on Scientific Activity and Higher Education are entered in the Register of scientific organisations⁵ managed by the MSE. According to the Register, there are 184 scientific organisations, which include 25 public research institutes and 92 higher education institutions, encompassing universities, faculties, university centre, university departments, art academies, polytechnics and schools of professional higher education.

Integrated and non-integrated universities in Croatia

Another crucial feature of the Croatian higher education system is the distinction between integrated and non-integrated universities⁶, which characterises the organisation and structure of components of Croatian public universities. This feature has implications on the way universities operate in the Croatian system, as detailed in Chapter 3.

Integrated universities are significantly smaller (and more recently established) than non-integrated universities in terms of the number of teachers, students, and study programmes. Their management and decision-making is centralised: that is the university rector and the university senate have full steering competencies and mandates. Integration is evident in all levels of activity – teaching, research, funding, knowledge exchange, etc. In that respect, all employees (including teaching and administrative staff) are employed by the university, even though they may be working at different components (departments) of the university. Unlike components of non-integrated universities, which are headed by a dean (in the case

⁵ http://pregledi.mzos.hr/Ustanove_Z.aspx

⁶ In addition to integrated and non-integrated universities, some public universities (University of Split, University of Rijeka and J.J. Strossmayer University in Osijek) follow the so-called semi-integrated model, that is some faculties are independent legal entities but the same time there exists university departments that are part of the university without being an independent legal entity.

of faculties), departments are run by a department head, an expert council, and other bodies whose structure, foundation, scope of activity, and authority are established by the university statute and general department rules.

Non-integrated universities are made up of faculties and academies that are independent legal entities and, as a consequence, have significant administrative and financial autonomy with respect to the university management (the rectorate and the senate). Faculties and academies are managed by a council and a dean who legally represent the faculty or the academy. Their academic and administrative activity is somewhat tied to the university in a bottom-up approach; however, they are not fully centralised or integrated, and their funding for the most part comes directly from the state budget, not from the rectorate.

In the recent past there have been attempts to encourage universities to move towards more integration, but these attempts did not manage to reform the Croatian higher education system and integrated and non-integrated universities still coexist today (OECD 2014). Chapter 3, describes more in detail advantages, disadvantages as well as possible ways to improve the current system of integrated and non-integrated universities.

Students and academic staff

According to the last available data of the CBS, in the winter semester of the academic year 2016/2017 the total number of students enrolled in undergraduate and graduate study programmes on Croatian HEIs amounted to 160,361, out of which the vast majority of students were enrolled in universities (80.2%), which is followed by polytechnics (13.6%), Schools of professional higher education (4.8%) and Art academies (1.4%). 85.5% of students was enrolled in the university studies, while the rest was enrolled in Professional studies. In the same academic year, the total number of students enrolled in the postgraduate studies amounted to 4,834, out of which 1,525 students (31.5%) were attending postgraduate specialist studies, while 3,309 (68.5%) attended postgraduate doctoral studies.

In terms of scientific field, the majority of students enrolled in postgraduate specialist studies were engaged in Biomedicine and health (50.95%), followed by social sciences (35.54%). On the other hand, doctoral studies are more evenly distributed, as the largest engagement is recorded in Biomedicine and health (22.79%) and Social sciences (22.03%), which are followed by Engineering (17.95%), Natural sciences (16.41%) and Humanities (13.48%) (CBS, 2017).

When observing the trends in the total number of students enrolled in HEIs, no significant changes were recorded in the last five years. Total number of enrolled students (165,195) indicated a slight increase in comparison to 2012 (0.35%), but also a somewhat stronger annual increase in comparison to the previous academic year (1.96%), (CBS, 2017).

According to the last available data, in the five year period 2012 - 2016, a significant declining trends in the number of students finishing their studies were recorded. During 2016, a total of 32,895 students graduated from institutions of higher education or have completed professional study. This was indicative of a significant decrease of 11% in comparison to 2012, while the recorded annual decrease in comparison to 2015 amounted to 5.3%. Furthermore, negative trends were more prominent when observing postgraduate studies. Namely, in the observed period the number of new masters and specialists decreased 67.8%, while the number of students to have successfully finished their studies decreased 51.7%, (CBS, 2017).

Overall level of tertiary education attainment in Croatia (population aged 25 – 64) significantly increased over the period 2007 – 2017 (82%) and it continues to rise on annual

basis. However, in terms of the tertiary attainment of the population aged 30 – 34, the data suggests further departure from the Europe 2020 goal⁷ of 35%. Namely, after the highest recorded level of attainment in 2014 (32.1%), a continuous decline was recorded in the following three years as the value of the indicator dropped to 27.3% in 2017. The same year average share of population aged 30-34 with tertiary education in EU amounted to 39.7%.

In the academic year 2017/2018, a total number of academic staff in HEIs amounted to 17,004, out of which the most common university title was Assistant professor (20.1%), followed by Assistants (18.1%), senior assistants (18.1%), Full professors (15.7%), Associate professors (11.4%), etc. The largest number of academic staff is employed in the University of Zagreb, which amounts to 39.2% of academic staff on Croatian HEIs, (CBS, 2018).

Funding of HEIs

According to the **Act on Scientific Activity and Higher Education**, the sources of financing for HEIs, research institutes and other research organisations include the founder's budget, the central state budget, local budgets of the counties, towns and municipalities, tuition fees, income from research, art and professional projects, research and professional elaborates and know-how, foundations, donations and assistances, income from publications, income from commercial activities, income from real estate, company stocks, income from commercial activities, as well as the income from investments made by natural and legal person. According to the same act, universities, polytechnics, professional schools of higher education and public research institutes cannot be financed from sources which can have an impact on their independence and integrity, while own income can be made only from activities that do not have a detrimental effect on the realisation of the subject's objectives.

The **National Council for Science, Higher Education and Technological Development (NCSHETD)** sets the criteria for the distribution of funds for science and higher education, based on the proposal by the expert body for financing the science and higher education system. The Ministry of Science and Education takes the criteria into account when proposing the budget for science and higher education. This proposal is also based on the collected proposed budgets provided by the science organisations, and HEIs, in accordance with the provisions regulating the planning and execution of the central budget.

Budgets are allocated to the HEIs in form of a lump sum that each HEI administers in accordance with the institutions' statute and other relevant acts. In case of universities, the budget is adopted by the university senate, while in case of polytechnics or schools of professional higher education the budget is adopted by a professional council. Constituents (such as faculties or departments) of the university distribute their share of the budget to contribute to the university budget for capital investments and development programmes.

Other sources of funding of HEIs encompass the implementation of research projects funded from EU funds, specifically European Regional Development Fund (ERDF), Cohesion fund (CF) and European Social Fund (ESF) i.e. through Operational programme competitiveness and cohesion 2014 – 2020 (OPCC) and Operational Programme Efficient Human Resources 2014 – 2020 (OPEHR).

7

After the reform of the Research and Innovation (R&I) system in 2013, the **Croatian Science Foundation (CSF)** became the main funding body for competitive research projects. This was implemented by transferring the allocation of competitive research grants from the MSE to the Foundation, in order to foster research excellence, competitiveness, as well as integration of Croatian research area into the European Research Area.

Higher education institutions conclude one-year or multi-year agreements with the Ministry of Science and Education on the subsidy towards the tuition fees payable by full-time students, with the purpose of ensuring equal access to higher education, stimulating completion of higher education, increasing enrolment rates in study programmes at HEIs and increasing the number of acquired qualifications in natural, technical, bio-medical and bio-technical sciences. In 2012, the Government adopted the proposal of the Ministry of Science and Education regarding subsidising tuition fees to all full-time students enrolled in public HEIs in academic years 2012/2013, 2013/2014 and 2014/2015, provided they fulfil the set requirements.

In October 2018 the Government adopted the decision on programme funding of public higher education institutions in the academic years 2018/2019, 2019/2020, 2020/2021 and 2021/2022. This new approach includes programme contracts with public higher education institutions (universities and institutes) for the duration of four years, defining goals, activities, outcomes, indicators and monitoring and evaluation. The new programme contracts aim to promote relevance in relation to labour market needs and social development, internationalization of higher education, and to make the science and education the drivers of societal change.

Private HEIs can also be funded from the state budget, on the basis of a previously concluded agreement, and provided that the HEI in question conducts activity for which the public needs exceed the provision of public HEIs or that a given activity is of a special national interest. Furthermore, private HEIs have to meet all the legally prescribed requirements and criteria as well as priorities set by the National Council, taking into account the available funds and the quality of the institutions.

Higher education policy framework

As mentioned in the previous section, the Croatian science and higher education system is regulated by the **Act on Scientific Activity and Higher Education** (*Official Gazette No. 123/03, 198/03, 105/04, 174/04, 02/07, 46/07, 45/09, 63/11, 94/13, 139/13, 101/14, 60/15*).

The public authority responsible for the higher education system in Croatia is the **Ministry of Science and Education** having the following tasks: "administrative and other tasks related to: the development of higher education; the implementation of national strategies and higher education programmes; the provision of funding and facilities for higher education institutions and monitoring their activities; the preparation of reports on the activities and evaluation of higher education institutions and study programmes, and their recommendation for approval; the subsidization of study costs; the improvement of the student standard; monitoring success rates of study programmes and other higher education processes; administering the implementation of the Croatian Qualifications Framework; administering the Registry of Higher Education Institutions and the Registry of Study Programmes; managing databases on higher education; fostering lifelong learning and higher education for adults; the administrative supervision of higher education institutions" (*Official Gazette No. 93/2016, 104/2016*, More details at <https://mzo.hr/en/brzi-linkovi/ministry>).

The Act on Scientific Activity and Higher Education mentioned above designates the **National Council for Science, Higher Education and Technological Development** as the highest expert body which is focused on development and quality of the overall scientific activity and scientific system, higher education and technological development in Republic of Croatia. NCSHETD is responsible for matters regarding scientific activity and higher education, as well as proposing and adopting measures for their improvement; tracking the development and determining the scientific and artistic areas and fields, naming the territorial scientific and artistic councils and parent committees for individual fields; determines the requirements for acquiring scientific grades; proposes criteria and relations of the budgetary funds for science, higher education and technological developments; appointing the members of the **Council for Financing Scientific Activity and Higher Education**; and other. The Council for Financing Scientific Activity and Higher Education is the expert body of the National Council whose 15 members propose the criteria for budgetary financing of scientific activity and higher education to the National Council.

The **Act on Quality Assurance in Science and Higher Education** (OG 45/09) regulates the procedures of quality assurance and improvement in science and higher education, such as initial accreditation, reaccreditation, thematic evaluation and audit. Furthermore, the Act defines the status, economic activity and the structure of the **Croatian Agency for Science and Higher Education (ASHE)** as the public institution focused on assurance and improvement of quality in science and higher education; as well other bodies which operate with the same goals as the Agency.

ASHE is an independent legal entity, which was modelled after the best European practices in quality assurance in science and higher education, and is a full member of **European Association for Quality Assurance in Higher Education (ENQA)**. The Agency implements activities for assurance and improvement of quality, such as initial accreditation, reaccreditation, thematic evaluation and audit; collects and processes information regarding the systems of science, higher education and other related systems; carries out the procedure of recognition of foreign HE qualification for the purpose of employment in accordance to the Act on Recognition of Foreign Education Qualifications (OG 158/03, 198/03, 138/06, 45/11; provides and collects information regarding the conditions for enrolment into HEIs in Croatia; carries out activities of connecting and affiliating with international associations and networks engaged in quality assurance in science and HE; implements activities related to development of scientific skills, knowledge and research and conducts educational activities on national level in terms of quality assurance; and other activities in accordance to other regulations.

Other Acts relevant in terms of the higher education system are the **Act on Croatian Qualification Framework** (OG 22/13, 41/16) and **Act on Recognition of Foreign Education Qualifications** (OG 158/03, 198/03, 138/06, 45/11).

The Act on Croatian Qualification Framework establishes the Croatian Qualification Framework (CROQF), determines its applications and its connections to the European Qualification Framework (EQF), Qualification Framework of the European Higher Education Area (QF-EHEA) and consequently national QFs of other countries. CROQF is an instrument for regulating the system of qualifications at all levels of education in the Republic of Croatia through qualification standards based on learning outcomes and following the needs of the labour market, individuals and society.

The Act on Recognition of Foreign Education Qualifications, among others, regulates procedures for the recognition of foreign tertiary education qualification in Croatia with respect both academic recognition and employment criteria.

Relevant strategic documents

The main objectives of the development of education and lifelong learning are determined by the European Union Strategy: **Europe 2020**, which is the successor of the Lisbon Strategy, developed for the period 2000-10. Europe 2020 aims to develop a “smarter, knowledge-based, greener economy, growing fast and sustainably, creating high levels of employment and social progress”. The goals highlighted in this strategy include a decrease in the rate of early leavers below 10 % and completion rate of tertiary education of 40% in the population aged 30-34 (in Croatia national target is 35%). Given the Croatia’s accession to the EU in 2013, all relevant policies were developed in line with this Strategy. The rest of this section provides an overview of relevant strategic documents in the context of higher education system and its role in innovation. These include:

The Strategy for Education, Science and Technology 2014 – 2020. The Croatian parliament has adopted the Strategy for Education, Science and Technology 2014 – 2020 on October 17th, 2014. By then, Croatia had become the member of the European Union, therefore the document was developed in compliance with the Horizon 2020 – The Framework Programme for Research and Innovation. The Strategy acknowledges science and education as national development priorities, especially in the context of recognizing the inadequacy of the educational structure and insufficient level of investment in science and technology. An increase of investment in R&D sector is stated as a priority with the accompanying goal to gradually raise its share in GDP from 0.75% to 1.4%, with a reference to the Europe’s 3% goal. Areas covered by the Strategy include the following:

- Lifelong learning
- Early and preschool, primary and secondary education
- Tertiary education
- Education of adults
- Science and technology.

Within the area of Tertiary education, the Strategy envisages 8 overarching objectives which are focused on upgrading the system of higher education in terms of improvement of study programmes through complete implementation of the Bologna reform; establishment of quality binary system of tertiary education in line with the national needs and the principles of efficient management of HEIs; ensuring quality structure of human resources on HEIs; ensuring an efficient system of funding the HEIs; ensuring adequate spatial and ICT resources; improvement of the student standard; internationalisation of higher education and its further integration to European and global higher education area; and implementing appropriate importance of the culture of quality and principle of responsibility in higher education.

In the area of science and technology, the Strategy recognises the importance of swift implementation of changes in the system of higher education and science; development of international competitive public universities and scientific institutes in Croatian higher education and research area, creating new scientific, social, cultural and economic value; development of the facilitating and enabling environment for interactions and collaborative transfer mechanisms between research community and innovative economies as well as

social activities; and inclusion of universities and polytechnics in the processes of smart specialisation and related guidelines of technological development.

The Smart specialisation strategy (S3). The Smart Specialisation Strategies initiative was launched by the European Union as a new approach to economic development based on targeted support of research and development activities and innovation as an engine for local economic development and renewal. It sets the strategic directions for the development of R&D activities in the following years in Croatia. The Croatian Smart Specialisation Strategy development is coordinated by the Ministry of Economy, Entrepreneurship and Crafts (MEEC), who drafted the analytical background for the S3 with the support of an EU co-funded expert team. The Smart Specialisation Strategy was adopted by the Croatian Government on 30 March 2016.

The overall strategic objective of the Croatian Smart Specialisation Strategy is to focus knowledge and innovation capacities into areas of greatest potential for Croatia to drive competitiveness and socio-economic development and transform the Croatian economy through effective RDI activities. On the basis of the overall strategic objective, specific strategic objectives that will direct policy initiatives and actions towards increasing smart, inclusive and sustainable growth have been identified and are mostly focused on increasing the capacities of RDI sector, overcoming the fragmentation of innovation value chain and the gap between research and business sector, increasing private R&D and non R&D investments, promoting internationalisation, addressing societal challenges and creating smart skills.

Beside the strategic objectives, S3 identifies five thematic priority areas (TPAs) with relevant technological and production fields as its main focus in Croatia:

- Health and quality of life,
- Energy and sustainable environment,
- Transport and mobility,
- Security,
- Food and bio-economy.

Furthermore, S3 identifies 2 main cross-cutting themes (Information and Communication Technologies (ICT), Key Enabling Technologies (KET) which represent cross-industry technologies and processes which are important for Croatian development because they are the additional source of innovation in all thematic priority areas, providing value-added support.

The purpose of this Strategy is to create a necessary stimulus for Croatian economy and increase its competitiveness by concentrating knowledge resources and linking them to a limited number of priorities. Specific measures will be implemented to raise competitiveness of thematic and sub-thematic priority areas through promoting RDI activities and investments, both in research organizations (including HEIs) and business sector.

The S3 Action plan envisages the implementation of the most relevant investments under ERDF - OP Competitiveness and Cohesion and through the ESF – OP Efficient Human resources, where a significant contribution to S3 implementation will be provided in the field of smart skills, (S3, 2016). Finally it has to be noted that, given the interdisciplinary nature of the Smart Specialisation Strategy, an **inter-ministerial working group** to follow the implementation of the strategy has been created. This working group includes

representatives from relevant ministries (Economic Development, Education and Science, Regional Development and EU Funds amongst others) and it is a positive attempt to promote inter-ministerial coordination around science and innovation issues.

The **Operational Programme Competitiveness and Cohesion 2014 – 2020**. The Operational Programme Competitiveness and Cohesion 2014 – 2020 was adopted by the Croatian Government and the European Commission in 2014. It presents a plan for the contribution to the Union's strategy for smart, sustainable and inclusive growth, and consequently achieving economic, social and territorial cohesion. Therefore, Croatia is committed to achieving faster and advanced smart growth, while further developing economic and social areas to ensure appropriate quality of life in all regions, comparable to the EU average. The funds from the projects developed under the OPCC are provided from ERDF (EUR 4.3 billion) and CF (2.6 billion). The Programme is divided into ten priority axes developed on the basis of 9 thematic objectives (the last priority axis being technical assistance) of the Common Strategic Framework and their respective investment priorities.

In the context of higher education system, OPCC envisages modernisation, improvement and expansion of accommodation infrastructure in higher education to improve access for disadvantaged students (Priority axis 9; Specific objective 2). However, the Programme also envisages developing links and synergies between enterprises, R&D centres and higher education sector in order to enhance research and innovation activities and foster knowledge and technology transfer (Priority axis 1; investment priority 1.b).

The **Operational Programme Efficient Human Resources (OPEHR)**. The Operational Programme Efficient Human Resource aims to contribute to creation of jobs and strengthening social cohesion in Croatia. Its total budget amounts to EUR 1.9 billion, while total EU contribution amounts to EUR 1.6 billion. The Programme is focused on four thematic priorities: Employment and labour market, Social inclusion, Education and training, Better public administration.

The Priority axis *Education and training* encompasses three investment priorities and respective specific goals, which are focused on improving the quality and efficiency of, and access to, tertiary and equivalent education with a view to increasing participation and attainment levels, especially for disadvantaged groups; enhancing equal access to lifelong learning for all age group; and improving labour market relevance of education and training systems, facilitating the transition from education to work and strengthening vocational education and training systems.

Many other documents in the fields of education, innovation and technological development, and consequently entrepreneurship are aligned, to a greater or lesser extent, with Horizon 2020, the Smart Specialisation Strategy and the Strategy of Education, Science and Technology. These include the Strategy for innovation encouragement of the Republic of Croatia 2014 – 2020, the Research and Innovation Infrastructures Roadmap, the Industrial Strategy of the Republic of Croatia 2014 – 2020, the Strategy for Entrepreneurship Development in the Republic of Croatia 2013 – 2020, etc.

HEIs and innovation – relevant actors in the Croatian Innovation System

The following actors are the main public bodies dealing with research and innovation policy. They define or manage policy schemes and instruments that – among others – include those schemes and instruments to promote collaboration between HEIs and the

business sector. For an overview of these schemes and instruments see Chapters 4 and 5. These main actors include:

- The **Ministry of Science and Education**, as mentioned above, represents the competent body for the R&D policies, while the innovation aspects of the systems are primarily dealt by the **Ministry of Economy, Entrepreneurship and Crafts (MEEC)**.
- Given the role of ESI funds on the financing of R&I activities, the **Ministry of Regional Development and EU Funds (MRDEUF)** also plays an important role in the RDI system, especially given its role as managing authority of the European Structural Funds.
- **National coordination bodies on science and innovation.** The already mentioned inter-ministerial working group to monitor the implementation is the Smart Specialisation Strategy is an operation body where representatives from different ministries discuss and monitor the progress of the S3 strategy. In July 2018, the Government decided to set up a National Innovation Council, to coordinate the implementation of the national smart specialisation strategy. This Council is co-chaired by the minister of Ministry of Science and Education, together with the minister of Ministry of Economy, Entrepreneurship and Crafts.
- The main funding body for competitive research projects is the **Croatian Science Foundation**, which is responsible for financing competitive research and also enhancing competitiveness and integration of the Croatian research area into the European Research Area. Other relevant bodies include the already mentioned **NCSHETD** and **ASHE** which also play the central role in the national higher education system. NCSHETD acts as the highest advisory body for the research, higher education and technology, while ASHE is responsible for establishment of national network for quality assurance and evaluation of scientific research and higher education.
- The **Croatian Agency for Small Business, Innovation and Investment (HAMAG-BICRO)** is responsible for implementation of all business R&I related ESIF measures as well as for providing support in implementation. In addition HAMAG-BICRO implements EUREKA/Eurostars programmes and is part of EEN network coordination innovation related activities within Croatia. HAMAG-BICRO provides SMEs and persons without a registered ownership of legal entity, with ESIF loans for investments which encompasses interest rates ranging from 0.5% - 1.5%, and the amount ranging from 1,000 EUR – 50,000 EUR. Furthermore, HAMAG-BICRO provides small and micro entities with loans for working capital encompassing the amount ranging from 1,000 to 25,000 EUR for interest rates between 1.5% and 3.5%. Furthermore, HAMAG-BICRO provides support to SMEs in terms of ensuring guarantees for investments, and therefore enabling the realisation of investments which would otherwise be impossible. Guarantees offered are National guarantees and ESIF guarantees. According to HAMAG-BICRO, over 720 loans and guarantees have been approved within the aforementioned instruments, which encompassed loans in the value of 184 million HRK and over 218 million HRK worth of guarantees. Number of loans approved in January 2018 amounted to 63, while the total number of approved loans in 2017 reached 575 (HAMAG-BICRO, 2018). However, despite the improved opportunities of financing innovative and fast growing high-tech companies in

Croatia due to availability of EU funds through the programmes of HAMAG-BICRO, the utilisation of such opportunities is still relatively low (Puljiz, J., et. al. 2017).

- The **Croatian Bank for reconstruction and development** (HBOR) also provides entrepreneurs with loans and guarantees. Specifically for start-ups, HBOR offers favourable loan conditions for citizens under 55 years of age, who do not own another company and do not hold over 30% of ownership interest, but are willing to start a crafts business, family farm or a company for the first time and will be actively and permanently employed in a responsible position within the newly established company. Borrowers can also be co-operatives and SMEs operating less than 2 years. The Start-up loan is intended for investments in fixed tangible assets, such as initial funding, land plots, buildings, equipment and devices, nucleus breeding unit and planting perennial crops (in case of farms), as well as fixed intangible assets, such as development of products or services, patents, licenses, copyrights, franchises. Also the loan can be used for financing permanent current assets, albeit up to 30% of the total loan amount. The loan, which can be implemented through commercial banks, risk-sharing model or direct lending, envisages the crediting amount between 80,000 HRK and 1.8 million HRK, with the usual interest rate around 2%.

In addition, there are around 25 private research organisations, which encompass either independent institutes (e.g. the Mediterranean Institute for Life Sciences) or belong to corporations (e.g. Ericsson Nikola Tesla). In the private business sector RDI activities are mostly concentrated in a number of large corporations, such as PLIVA (pharmaceuticals), Podravka (food industry) and Končar – Electrical Engineering Institute.

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Chapter 2. Applying HEInnovate to Higher Education in Croatia⁸

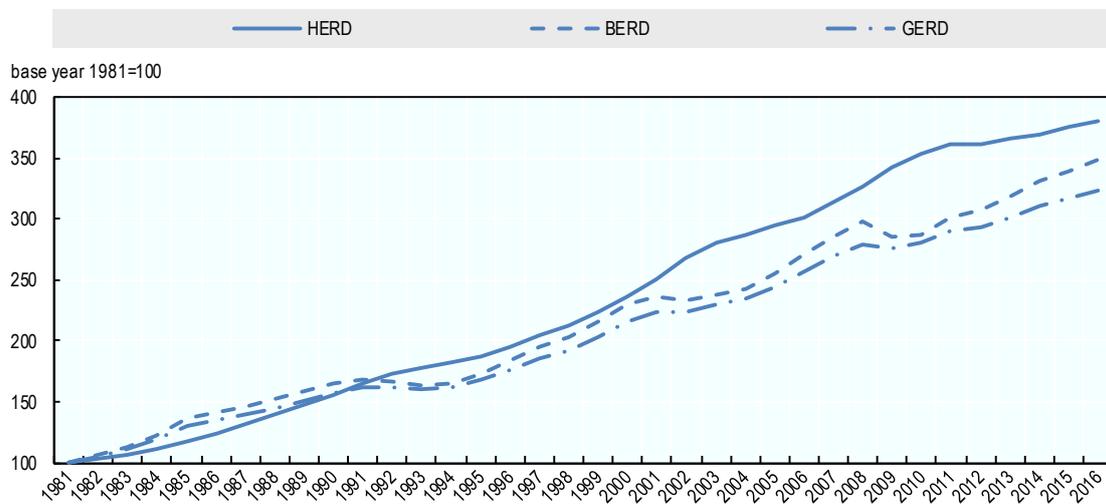
This chapter presents the HEinnovate guiding framework developed by the OECD and the European Commission to assess innovation and entrepreneurial capacity of higher education institutions. It presents the eight dimensions that this holistic framework uses to look at Higher Education Institutions' innovative and entrepreneurial drive (such as entrepreneurial teaching and learning, knowledge exchange activities and digital transformation and capability). For each of these eight dimensions it describes good practices an HEI should follow drawn from best practices observed by the HEinnovate team in different HEIs. Furthermore, the chapter looks at activities and practices implemented by Croatian HEIs.

⁸ In the context of this report HEI refers to Croatian Universities, Polytechnics and Schools for professional higher education, but not to individual Faculties within a University.

The HEInnovate guiding framework

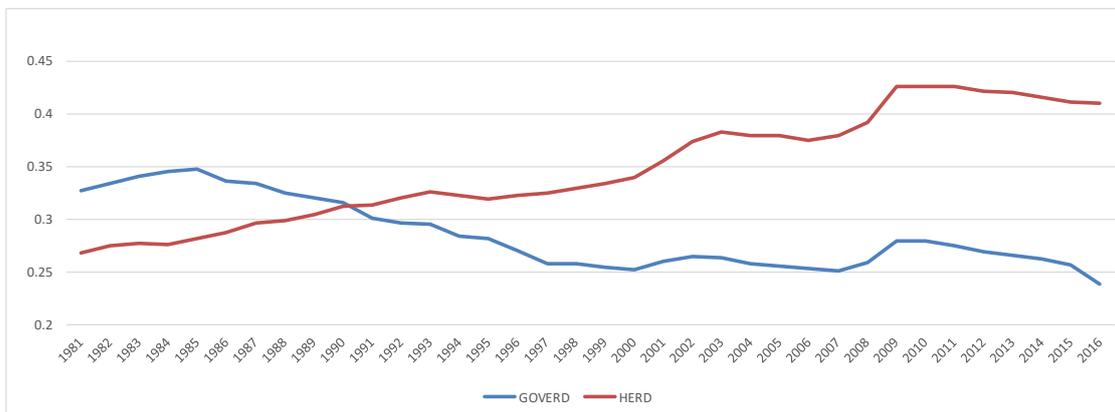
In recent decades, the missions and mandates of higher education institutions have become more complex and their activities have broadened, both in OECD countries and emerging economies. For instance, as illustrated in Figures 2.1 and 2.2, HEIs have considerably expanded their R&D activities since the 1980s, partly at the expense of public research organisations. In the OECD area, HEIs’ R&D expenditures have increased more rapidly than R&D expenditures in the business and government sectors (OECD 2017a).

Figure 2.1. R&D expenditure - trends over time



Note: 1981 = 1
Source: OECD MSTI Database.

Figure 2.2. R&D performed by HEIs and government research centres



Source: OECD MSTI Database

Moreover, the increasing role of HEIs in national innovation systems and their expected contribution to economic growth, social and cultural development has put an increasing demand on HEIs on knowledge-exchange and technology transfer with economic players.

This transformation has gone hand in hand with other global trends:

- In many OECD countries and emerging economies, the governance of HEIs has been decentralised. This has often resulted in a greater autonomy of HEIs combined with shifts in funding towards greater emphasis on performance and competition. This has allowed HEIs to autonomously allocate resources, set strategic targets and shape their own profiles in research and education. Research suggests (Aghion et al. 2010) that the shift towards greater autonomy of HEIs has had a positive impact on HEIs performance.
- Globalisation has been affecting the way that HEIs interact and compete at the international level. An increasing participation in international science and innovation networks has enabled greater international exchange and mutual learning in research activities and education practices. It is also, however, leading to increased competition between institutions for attracting and retaining talented students and researchers.
- The changing context for HEIs has put more emphasis to the concepts of the ‘third mission’ and the ‘entrepreneurial university’ (OECD 2017a, Etzkowitz et al. 2000, Gibb 2013, heinnovate.eu). The third mission of HEIs refers to all the activities that go beyond the two core missions of HEIs: education and research functions of HEIs. These activities can be very broad and diversified and take place at different geographical scales (international, national, local). As mentioned above, one of the key third mission activities of HEIs is ‘knowledge exchange’ with business, public organisations, and the society more broadly (OECD 2007, Goddard 2013, OECD 2017a; see Chapter 5 in this report for a more detailed overview of “knowledge exchange”). This is also a key feature of what is known as the entrepreneurial university.

To support policy makers and HEI leaders to make the most of these transformations, the OECD and the European Commission have developed collaboratively HEInnovate, a guiding framework for innovative and entrepreneurial HEIs. The stimulus for HEInnovate was the University-Business Forum in March 2011, an annual event organised by the European Commission for HEIs and their key strategic partners. Delegates expressed a need for support and guidance in implementing practices that will help them become more innovative and entrepreneurial institutions. The HEInnovate guiding framework is developed around 8 dimensions defined and detailed in the next sections of this chapter.

Other elements of the HEInnovate framework include the following:

- **The HEInnovate self-assessment tool (www.heinnovate.eu).** The HEInnovate self-assessment tool was conceived for individual Higher Education Institutions who wish to explore their innovative potential. It guides HEIs through a process of understanding, prioritisation and action planning in the eight key dimensions: leadership and governance; entrepreneurial teaching and learning; organisational capacity: funding, people, incentives; preparing and supporting entrepreneurs; knowledge exchange and collaboration; the internationalised institution; measuring impact; digital transformation and capability. HEInnovate also identifies areas of strengths and weaknesses, opens up discussion and debate on the innovative and entrepreneurial nature of individual HEIs and it allows compare trends over time. The self-assessment tool gives instant access to results, learning materials and a pool of experts.

- **The HEInnovate Country Reviews.** The Heinnovate Country Reviews have been developed to provide a national systemic perspective about innovation in national higher education systems. They complement the HEInnovate tool that targets for individual HEIs, by providing a systemic perspective and taking into account the different roles and features of different HEIs in a national system. HEIs do not operate in isolation but collaborate with their community and compete with other HEIs in the same country (and abroad) in a varieties of fashions. The Country Reviews were developed to capture and assess these complex interactions and dynamics. At the time of writing, Country Reviews had been completed for the following OECD or EU countries: Ireland, Hungary, the Netherlands, Poland, Bulgaria (OECD 2018a, OECD 2017b, OECD 2017c, OECD 2017d, OECD 2015a).
- **The HEInnovate Policy Learning Network.** The HEInnovate Policy Learning Network (PLN) was established as a platform of peer-learning and policy dialogue among policy makers of the countries participating in HEInnovate Country Reviews. The participants of the PLN meet and discuss regularly about key themes linked to the HEInnovate 8 dimensions and relevant for their countries. It is a platform to learn and compare from similar experiences across OECD and EU countries.

The HEInnovate 8 dimensions in the Croatian context⁹

Leadership and governance

The HEI leadership and the way its governance is organised are key to developing an innovative and entrepreneurial culture within the HEI. Leadership and governance arrangements are crucial to define the framework of incentives to promote change and innovation within higher education institutions. Many HEIs across OECD and EU countries include the words ‘innovation’ and ‘entrepreneurship’ in their mission statements, but in an innovative and entrepreneurial institution this is more than a reference. The statements that follow highlight some of the important factors an HEI may consider in order to strengthen its innovation and entrepreneurial agenda.

The HEI presents its entrepreneurial and innovative vision in its strategic documents

An HEI should see itself as an innovative and entrepreneurial organisation, having a common vision, values and mission. To promote innovation and the development of an entrepreneurial mind-set, the strategy of an HEI should reflect its innovative and entrepreneurial aspirations and agenda. The HEI could for instance have a mission statement and written strategy, setting out an entrepreneurial vision for the future of the institution. This strategy could clearly emphasise the importance of entrepreneurship, culturally, socially and economically. In addition to the strategy, it is equally important to

⁹ This study applies the HEInnovate framework organised around the 8 dimensions described in this section. However, at the request of the Croatian Ministry of Education and Science, it focuses primarily on the following 3 dimensions: Organisational capacity: funding, people, incentives; Preparing and supporting entrepreneurs; Knowledge exchange and collaboration. The next chapters will cover these 3 dimensions in detail.

articulate a clear implementation plan with detailed objectives and define key performance indicators to measure progress.

Not all HEIs in Croatia have developed yet clear strategies targeting innovation and entrepreneurship. Many HEIs do not necessarily explicitly mention innovation and entrepreneurship on their websites and in their written strategic documents. This is an indication that, while many bottom-up practices have been developed, in general there is a limited awareness about innovation and entrepreneurship in high-level strategic documents.

There is commitment at a high level to implementing the entrepreneurial agenda

A deep commitment at senior management level of an HEI is needed to drive the implementation of the innovation and entrepreneurial agenda. This commitment could take several forms, for example, it is important to communicate the strategy across the institution, and make sure that it is understood as a priority by staff, students and also external stakeholders. In some cases it may mean to appoint a dedicated person at a high level/senior management responsible for the implementation of the innovation and entrepreneurial vision and strategy. Another important element is the regular review and revision of the entrepreneurial strategy to keep it up-to-date and relevant in local, national and international contexts.

The level of commitment towards the implementation of innovation and entrepreneurship strategies varies from HEI to HEI. For example, some HEIs have clearly shown commitment towards innovation and entrepreneurship. These include individual teams in the Universities of Rijeka, Dubrovnik, Split, Zagreb, J.J. Strossmayer in Osijek, Polytechnic VERN' etc.

Given the specific governance of Croatian HEIs (see Chapter 1 and 3) in some cases innovation and entrepreneurship strategies and their implementation are left to deans rather than to the Rector's team. This has the consequence that if no strong coordination mechanisms are in place, especially in non-integrated universities, many individual strategies and action can be (and are) developed at the faculty level with no central coordinating mechanisms. This has led, in some universities, to the creation of multiple infrastructure (such as incubators, TTOs, etc.) at the Faculty level rather than at the university level. This may cause fragmentation and duplication of such activities in a system where resources dedicated to innovation and entrepreneurship are already limited. In addition, as innovation and entrepreneurship require multi-disciplinary approaches it is very important to ensure a constant dialogue across different faculties and departments. It is therefore important that coordination and steering mechanisms are in place to make sure that actions are directed towards common visions and goals to avoid fragmentation of resources and investments.

There is a model in place for co-ordinating and integrating entrepreneurial activities across the HEI

An HEI needs an effective model for co-ordinating and integrating innovative activities across the institution. There are a variety of models which can be used, such as, a dedicated person at senior management level, a dedicated unit close to senior management, coordination mechanisms across departments, faculties or other units and centers, the establishment of an innovation or entrepreneurship centre within the HEI. It is also

important that the HEI coordinates its activities with other relevant stakeholders within the local innovation eco-system.

As explained in Chapter 1 and 3, as well as in the paragraph above, the current governance system of Croatian HEIs (that is integrated vs. non-integrated universities) may affect the development of horizontal coordination mechanisms, especially across faculties of non-integrated universities. The lack of strong coordination mechanisms affects these HEIs in general and also applies to innovation and entrepreneurship activities. Integrated universities, instead, have a better capacity to establish central steering and coordination mechanisms. Non-integrated universities may overcome the challenge of the lack of coordination by developing cross-faculty working groups dedicated to research and innovation activities.

The HEI encourages and supports faculties and units to act entrepreneurially

An HEI with open and flexible approaches finds it easier to undertake innovative activities and speed up decision-making. An HEI should provide an environment that encourages idea creation and the emergence of new activities and initiatives.

Given the high degree of decentralisation of the Croatian higher education system, faculties and departments have, in general, the possibility to take full responsibility and ownership of innovation and entrepreneurial activities. Some initiatives, indeed, are mostly developed with bottom-up approaches at the faculty level, especially in larger non-integrated universities. This has some advantages as each faculty is more agile and able to quickly take and implement decision autonomously. However, there is a risk to develop many fragmented activities of small scale. This could be nevertheless avoided if well-functioning coordination mechanisms were in place.

The HEI is a driving force for entrepreneurship and innovation in regional, social and community development

An HEI can play several roles in its community and wider surrounding ecosystem. One of the key functions of an HEI is to contribute to and support regional, social and community development. There are several ways an HEI can contribute to this. An HEI can be for instance actively involved in the development and implementation of the local, regional and national innovation and entrepreneurship strategies. It can co-develop study programmes with business partners or other stakeholders to support local job markets and skills development. It can also support local partners by providing general access to the facilities of the institution to others in the wider community. Other channels include the support of start-ups and established companies in the region to enhance innovation and entrepreneurship. An HEI can also have a strong presence in its communities, for example, by supporting local cultural and artistic activities.

Several HEIs in Croatia play an active role in their local innovation eco-systems. Interesting examples include: the J.J. Strossmayer University in Osijek and its centers developing collaborations with relevant industries for the region, the Polytechnic VERN' Vis Island Campus, and activities developed in HEIs in Dubrovnik, Rijeka, Zagreb, Velika Gorica (see chapter 5 for more details). However, as explained in the next sections, in most HEIs, these activities are bottom-up, often driven by the motivation of “innovation and entrepreneurship” champions in the HEI rather than being part of an overarching strategic vision for innovation, entrepreneurship and knowledge exchange.

Organisational capacity, funding, people and incentives¹⁰

The organisational capacity of an HEI drives its ability to deliver on its strategy and implement any action to translate the strategy into practice. However a strategy alone is not enough. If an HEI is committed to carrying out innovative and entrepreneurial activities to achieve its strategic objectives, it needs to fund and invest in these areas accordingly and consistently. People are, of course, essential: they need to have or acquire the skills, the expertise and the knowledge to transform the HEI into a more innovative and entrepreneurial organisation. Finally, properly designed incentive mechanisms for researchers, staff, students and also external stakeholders, need to be in place to promote and strengthen innovative and entrepreneurial practices in the HEI.

Entrepreneurial objectives are supported by a wide range of sustainable funding and investment sources

Becoming an innovative and entrepreneurial HEI is an incremental and long-term organisational development process that requires a sustainable and diverse financial basis and access to key resources and investments. Success factors are for example the following: a strong alignment between investments in innovative and entrepreneurial activities and the HEI overall financial strategy; a continuous and long-term engagement with funders and investors, also outside the academic world, to secure financial resources to deliver strategic objectives; a balanced and diversified range of funding and investment sources, including in-kind contributions; the possibility to re-invest revenues generated from research, teaching and knowledge exchange activities.

Funding for innovation and entrepreneurship activities is not always allocated with a long-term vision in the Croatian higher education and innovation system. It is often linked to EU budget and funding opportunities and when this source of funding runs out there is no guarantee of stable long-term funding commitments. Faculties and departments' main funding streams are dedicated to staff and their teaching loads rather than to entrepreneurship and innovation activities, with stable and long-term budget allocations

The HEI has the capacity and culture to build new relationships and synergies across the institution

All internal stakeholders, staff and students, have a role in supporting an HEI's entrepreneurship and innovation agenda. Encouraging dialogue and synergies between the administration, academic faculties and staff, students and management helps break down traditional boundaries, foster new relationships and exploit internal knowledge and resources. Several approaches can support these synergies, for example, promoting a shared usage of facilities across faculties, establishing structures to encourage dialogue between students and staff as well as decision makers, creating and supporting inter-disciplinary structures, such as the creation of cross-faculty teaching and research groups.

As described in Chapter 1 and 3, the Croatian higher education system is fragmented, especially in non-integrated universities, where the steering mechanisms tend to be weak.

¹⁰ This study applies the HEInnovate framework organised around the 8 dimensions described in this section. However, at the request of the Croatian Ministry of Education and Science, it focuses primarily on the following 3 dimensions: Organisational capacity: funding, people, incentives; Preparing and supporting entrepreneurs; Knowledge exchange and collaboration. The next chapters will cover these 3 dimensions in detail.

If, on one hand, this has the advantage to allow faculties to quickly take decisions and develop bottom-up activities, the current structure does not promote cross-faculty collaboration and coordination. This has negative consequences for the establishment of inter-disciplinary teaching and learning as well as cross-faculty research activities or knowledge exchange within and outside the HEI.

The HEI is open to engage and recruiting individuals with entrepreneurial attitudes, behaviour and experience

An HEI can build an entrepreneurial and innovation culture by engaging stakeholders with a strong entrepreneurial background and experience. These individuals can bring different viewpoints, knowledge, and expertise unavailable internally. Such individuals can be permanent members of staff, guest contributors, visiting associates or external stakeholders.

In Croatia it is neither easy nor common to recruit academic staff from outside the academia. Academic staff needs to have completed a PhD to be able to teach to students in university programmes and this can be in some cases a blocking factor to attract individuals (such as entrepreneurs) with relevant background to the universities. In addition, teaching loads are quite heavy in Croatia and therefore the incentives to perform entrepreneurial activities or develop entrepreneurial attitudes for many researchers and professors can be limited. However, many small and newer HEIs in Croatia are attempting to increase the number of staff with industry background, this is often the case of polytechnics and schools for professional higher education. Examples include the case of Polytechnics VERN' and Velika Gorica.

The HEI invests in staff development to support its entrepreneurial and innovation agenda

Staff, both academic and administrative, are a key and necessary resource required to deliver on all elements of an HEI's innovation and entrepreneurial agenda. These include the delivery of entrepreneurship education, provision of support for business start-ups, development of partnerships with other external stakeholders and supporting local and regional development. To support these activities, some HEIs in OECD countries have established formal criteria for career development for staff linked to the implementation of the institution's entrepreneurial strategy and vision; have set individual objectives and performance indicators supporting the implementation of the entrepreneurial agenda; have been measuring staff progression against these objectives on a regular basis; have linked the training needs of staff with career objectives that support the entrepreneurial agenda.

Currently in Croatia the incentives for academic staff and students to take part of innovation and entrepreneurship activities are limited. Career incentives and rewards mechanisms are defined at the national level and applied to all HEIs in Croatia (although private HEIs appear to have more flexibility). Most career progression criteria are linked to research performance and the main requirement for academic staff is the annual teaching load. There are currently limited incentive mechanisms to reward or support staff engaging in activities beyond research and teaching.

Incentives and rewards are given to staff and students who actively support the entrepreneurial agenda

Encouraging and rewarding innovative and entrepreneurial behaviour in staff and students is a key feature of innovative and entrepreneurial HEIs. The innovative and entrepreneurial behaviour of staff and students relates to staff and students seeking to become entrepreneurs but also staff and students who actively seek new opportunities to bring innovation and entrepreneurial behaviour within the HEI. Well-designed incentive and reward mechanisms should be diverse and differentiated to be able to promote different types of careers and actions depending on the different types of skills of staff. These incentives and rewards mechanisms should be available at an individual level as well as for faculties or departments, extending beyond classic career progression models.

Examples of good practices to reward this type of behaviour include: adjusting staff teaching and research workloads for those who take on new responsibilities that support the institution's entrepreneurial agenda; providing institutional funds to staff to stimulate innovation and change; allow sabbaticals for staff who seek to enhance their entrepreneurial capacity; develop rewards and incentive mechanisms going beyond traditional research, publications and teaching metrics; making office and laboratory space available for staff and students to pursue entrepreneurial activities; developing flexible IP protections models.

Currently incentives and rewards for academic staff and students involved in innovation and entrepreneurship activities are very weak in Croatia. Teaching loads are the same for all teaching staff, irrespectively of their skills, attitudes and interests and career advancement criteria are mostly based on bibliometric indicators. Students often take part of these activities in their free time and beyond regular curricular engagements. Despite the lack of incentives, many innovation and entrepreneurship activities are being developed, but they are generally not taken into account in evaluations, promotions or exams.

Entrepreneurial teaching and learning

Entrepreneurial teaching and learning is about exploring innovative teaching methods and finding ways to stimulate entrepreneurial mind-sets. This involves learning about entrepreneurship and how for instance to start a new company, by receiving training on support mechanisms, tax rules, financial schemes and other private or public policy support. However, it means acquiring the skills and competences for developing entrepreneurial mind-sets, which are often associated to the ability to tackle problems with a variety of methodologies and inter-disciplinary approaches, problem solving skills, and more in general soft skills such as communication, management, organisational skills, etc. This can be achieved, for instance through, problem-based learning, inter-disciplinary courses, internships, team work assignments, etc.

In Croatia, HEIs are mostly responsible for traditional teaching and learning. To date, there is no coherent framework for entrepreneurship education at the national level. However, many (often bottom-up) initiatives are currently being developed by several HEIs or research units, or in some cases by highly motivated students, as in the case of the Racing Team at the University of Zagreb.

The HEI provides diverse formal learning opportunities to develop entrepreneurial mind-sets and skills

An innovative and entrepreneurial HEI provides a range of learning opportunities to facilitate innovative teaching and learning across all faculties. Such an HEI should be encouraging innovation and diversity in its approach to teaching and learning across all faculties and departments as well as developing entrepreneurial mind-sets and skills across all programmes.

A range of practices can promote the development of an entrepreneurial mind-set across students and staff. Examples to promote these skills across students include supporting change in curricula to stimulate and develop entrepreneurial mind-sets and skills through, for instance, new teaching methods, student-centred, cross-disciplinary and project-based learning (e.g. internships, business competitions, living labs, the use of case studies, hackathons, games and simulation). Academic staff can also take part in these activities as organisers or participants. Staff can receive training to acquire entrepreneurship skills and knowledge on how to create a business but also training to support inter-disciplinary teaching and research methods.

These innovative teaching methods are not widespread in Croatian HEIs. As described in Chapter 1 and 3, universities in Croatia suffer from fragmented governance structures that do not encourage or incentivise cross-disciplinary teaching and learning and related activities. This problem is particularly acute in non-integrated universities, where it is more difficult (although not impossible) to develop cross-faculty activities.

The HEI provides diverse informal learning opportunities and experiences to stimulate the development of entrepreneurial mind-sets and skills

Extra-curricular learning opportunities are an important complementary part of entrepreneurship teaching and learning provision. An innovative HEI should offer a range of informal learning opportunities to students to inspire individuals to act entrepreneurially. For example it can organise networking events between students and entrepreneurs/businesses and engage students in business idea/plan competitions as part of their extra-curricular opportunities. These initiatives are more effective when these extra-curricular activities are formally recognised (for examples in exams or other evaluations).

Most HEIs in Croatia organise some forms of networking events and offer students the chance to participate in competitions. These initiatives are typically appreciated by students. However they are rarely acknowledged and recognised in curricula and there is no widespread incentive mechanisms to increase participation in such programmes.

The HEI validates entrepreneurial learning outcomes which drives the design and execution of the entrepreneurial curriculum

An entrepreneurial learning experience is essential for both graduate entrepreneurs as well as entrepreneurial graduates entering into employment. An HEI that values entrepreneurial learning commits to regular review, validation, and the update of curricula content and learning outcomes across all study programmes.

Monitoring and evaluation of entrepreneurial learning outcomes is not common in Croatian HEIs. In this respect, the usage of the HEInnovate tool can be a useful reference to start the discussion on possible ways of monitoring and evaluation. Some initial discussions are taking place at the national level about possible ways to capture these outcomes.

The HEI co-designs and delivers the curriculum with the external stakeholders

External stakeholders are an important source of expertise that can be used in entrepreneurial teaching and learning. External stakeholders can participate into the development and delivery of extra-curricular learning activities and support services. Regular engagement with external stakeholders encourages long-term collaborative relationships that can provide useful inputs to understanding future skills needs as well. A wide range of external stakeholders can be useful in this respect. This is why it is important to support a broad range of collaborative partnerships with local communities and organisations, local and regional governments, chambers of commerce, industry and HEI alumni.

HEIs in Croatia collaborate and exchange knowledge with external stakeholders in a variety of fashions (Chapter 5). Nevertheless, the design and delivery of curricula is in most cases traditional and does not heavily involve external stakeholders such as the business sector, regional and local agencies and authorities. Notable examples where found. For instance, the Faculty of Electrical Engineering, Computer Science and Information Technology in Osijek recently established a new automotive study programme attracting key industry partners. Collaboration with industrial partners in the design of curricula is more widespread in the case of Polytechnics, including in the ones visited (VERN¹¹, Velika Gorica, and Zagreb).

Results of entrepreneurship research are integrated into the entrepreneurial education offer

For a curriculum to stay up-to-date and relevant, the entrepreneurial education offer needs to be continuously reviewed and updated. Therefore an HEI should integrate the results of entrepreneurship research into its teaching. Every HEI could, for example, encourage staff and educators to review the latest research in education, including entrepreneurship education, provide a forum whereby staff and educators can exchange new knowledge and ideas, incorporating the latest research, provide access to inspiration from other HEIs through networking and sharing good practices.

To date, and also partly because entrepreneurship teaching and learning is not yet fully developed in Croatia, there is no widespread integration of the results of entrepreneurship research in the education programmes of HEIs. This would be a welcome development in the education offer.

Preparing and supporting entrepreneurs¹¹

HEIs can help students, graduates and staff considering starting a business as a career option. HEIs can have an important role to help individuals reflect on the commercial, social, and environmental or lifestyle objectives related to their entrepreneurial aspirations and intentions. This does not mean necessarily starting a business, but rather developing an entrepreneurial mind-set and the related skills necessary to work creatively also as an employee. For those who decide to proceed to start a business, or any other type of venture, HEIs can offer targeted assistance to generate, evaluate and act upon new ideas, building the skills necessary for successful entrepreneurship, and importantly find relevant team members and get access to relevant networks. It is important to remember, however, that context matters (OECD 2011): the support measures described above are likely to be

¹¹ This dimension is covered in detail in Chapter 4.

effective when the entrepreneurship and innovation eco-system surrounding the HEI is well developed and well-functioning. This happens when HEIs act as part of a wider business and innovation support ecosystem rather than when they operate in isolation.

The HEI increases awareness of the value of entrepreneurship and stimulates the entrepreneurial intentions of students, graduates and staff to start up a business or venture

Raising awareness of entrepreneurship in an HEI is about helping people make informed decisions about their careers, including the option of starting an enterprise. HEIs can help this process by providing support for those individuals who want to start-up a company. This support can take different forms, such as informing staff about IPRs regimes at the national and HEI level, enabling staff to own shares, work part-time, take sabbaticals, and the possibility for students to extend the duration of their study programmes to support starting a new venture while working or studying. Equally important is to celebrate and recognise successes of student, graduate and staff that became entrepreneurs.

Academic spin-offs are not common in Croatia and the good practices described above are not widespread. This is the results of a number of factors including: a historical heritage and culture that is not supportive for entrepreneurship in general and academic spin-offs in particular, the lack of framework conditions conducive to entrepreneurship at the national level, weak local innovation eco-systems where academic spin-offs can flourish, and the lack of a well-organised and structured support for academic entrepreneurs in most HEIs and also at the national level. It is important to remember that HEIs alone cannot solve these issues. Therefore while encouraging HEIs to develop a more structured support for wannabe entrepreneurs within the HEI, relevant national actors should also pay attention to the other factors affecting entrepreneurship and innovation in Croatia more in general

The HEI supports its students, graduates and staff to move from idea generation to business creation

An HEI can support motivated students, graduates and staff in taking their first steps in preparing for a start-up. This includes helping entrepreneurs at different stages: developing an idea, finding a team, and exploring the technical and market feasibility of a project. As well as introducing staff to new networks, an HEI can offer regular activities to generate and evaluate business ideas emerging across the institution. Support measures for students and staff include different types of measures from team building and conflict management support, to advice regarding intellectual property (IP) issues, to the organisation of idea and start-up pitch prizes, etc.

Commercialisation of public research (through patents or academic spin-off or start-ups) happens very rarely in Croatian HEIs. Only a few HEIs have applied for international patents and the number of patent applications rarely exceeds 5-6 per year¹² in the case of larger HEIs. Spin-offs also are almost non-existent. Many universities, but not all, in Croatia have developed some forms of support for students and staff wanting to create a business. Some HEIs but not all have established TTOs, they are however very small (with a maximum of 9 people¹³ working in them in the University of Zagreb, the largest in the country) and often under-funded. It has to be noted however that the small size is also due

¹² Data provided to the OECD team by the universities that received study visits

¹³ Data provided to the OECD team by the universities that received study visits

to the limited demand for such services, linked to the lack of incentives and appetite for researchers and students to approach TTOs to develop ideas and start-up companies as well as weak framework conditions at the national level conducive to entrepreneurship and innovation (Chapter 4). Like for many other entrepreneurship and innovation activities, the type of support is often linked to the motivation of individual researchers and students rather than to an overarching strategy and related support structure.

HEIs are free to develop their own IP policies in Croatia. However, many HEIs have not yet developed clear IP framework and guidelines. Some other have, for example the University of Zagreb and Split apply the 40-40-20 rule. That is 40% of the revenues of the invention belong to the researcher, 40% to the faculty and 20% to the university¹⁴. However, many researchers and students do not appear to be fully aware of IP rules in Croatian HEIs, probably also due to the very low number of academic spin-offs and other technology transfer deals. Clarifying IP rules and regulation at the national, HEI and also faculty/department level would be an important welcome step that could support academic entrepreneurship in the future.

Training is offered to assist students, graduates and staff in starting, running and growing a business

Entrepreneurship training can provide some of the skills and competences needed to start, run and grow a business. The training should impart relevant knowledge and skills about a wide range of topics, for example financing, legal and regulatory issues, but also the development of soft skills such as dealing with people and building relationships, managing innovation processes, coping with success, stress and risk, and how to restructure or exit. Emotional preparation is as important as the technical aspects. The involvement of entrepreneurs and key actors from the entrepreneurship ecosystem is often very useful in the approaches described above.

Many HEIs in Croatia offer entrepreneurship training, which is however in most cases not widespread across different faculties. As already mentioned, entrepreneurs and non-academic individuals are involved in some courses but not on a regular basis in most HEIs.

Mentoring and other forms of personal development are offered by experienced individuals from academia or industry

Mentoring and other personal development relationships (such as coaching and tutoring) can help start-up entrepreneurs identify and overcome problems and develop their business networks. They provide valuable support in the form of knowledge, experience, social capital and encouragement on a long-term basis. In many HEIs, mentors and coaches tend to be experienced (academic) entrepreneurs, company managers and often alumni.

Mentoring is not well developed in Croatian HEIs. Students and staff can discuss with experienced researchers but the level of engagement of the latter varies and it is generally not recognised or rewarded by the national promotion criteria or by individual HEIs. Mentors from the business sectors are less common. As already discussed alumni networks are not well developed. There is certainly scope for strengthening and developing further mentoring activities in HEIs in Croatia.

¹⁴ Information provided to the OECD team by the universities that received study visits

The HEI facilitates access to financing for its entrepreneurs

External financing can be essential for the success of the initial stages of a new venture, e.g. providing investment for feasibility and market studies, product and prototype development such as proof of concept funding, for initial production or for offering the founders some living income before their first revenues are generated. HEIs with well-developed start-up support often offer financial education to potential entrepreneurs to better understand different financial schemes and how to use them. HEIs can also be instrumental in the organisation of pitch and prizes idea competitions as a way to connect wannabe entrepreneurs with networks of potential investors (business angels, seed and VC investors, etc.).

Access to finance for wannabe entrepreneurs is a challenge in Croatia, this also applies to students or academics wanting to develop a spin-off from their HEI. Networks of business angels, seed and VC investors are nascent and not yet fully developed. HEIs are generally not used to interact with these networks and link them to students and staff.

The HEI offers or facilitates access to business incubation

Business incubators commonly provide a range of services such as free or subsidised premises where start-uppers can work on their projects, access to laboratories and research facilities, prototyping support, as well as advice on IP matters and financial opportunities. They also offer a visible and accessible location for entrepreneurs to access an integrated package of coaching, mentoring, and training.

Some HEIs in Croatia have developed or are developing incubators or TTOs. However, the number of start-ups they are hosting is typically very low and only a very limited number reaches the market stage. This is not surprising given the limited incentives at the national and HEI level, the limited collaboration on research and innovation between HEIs and the business sector as well as the systemic constraints discouraging innovative entrepreneurship in the country.

An interesting initiative has been developed by the University of Zagreb Faculty of Electrical Engineering and Computing (FER). The Innovation Centre Nikola Tesla (ICENT, <http://www.icent.hr/en/>) is a non-profit research institute owned by the FER, which integrates scientific research, innovation and commercial processes for setting up new industrial technologies, products, services and business models. ICENT is newly formed organization which role shall be facilitation of research results commercialization and better connection between FER and industry partners in the field of applied research.

Digital Transformation and Capability

HEIs are already and increasingly deploying digital technologies, however the uptake and integration varies among and within institutions. HEIs should make the most of the opportunities presented by the digital transformation and consider digital technologies as a key enabler. The HEI's digital capability, refers to the ability to acquire, integrate, use, optimise and transform digital technologies to support innovation and entrepreneurship in higher education. This dimension has been officially launched in June 2018. At the time of the study visits of the HEInnovate Review of Croatia, it was not yet explicitly part of the HEInnovate framework. The information on the level of digital activity of Croatian HEIs is therefore limited.

The HEI fosters a digital culture as a mean for innovation and entrepreneurship

Digital tools and practices are drivers of innovation and entrepreneurship (OECD 2018b, OECD 2017b). An HEI should understand, explore, and promote new ways of working with a strong vision based on digital-first thinking. A well-functioning digital culture balances top-down leadership while welcoming bottom-up innovation. This includes a coherent and shared strategy and action plan allocating resources for digital transformation across the HEI.

As most HEI in OECD and European countries, Croatian HEIs are developing digital activities. However there is often no formal overarching strategy to promote a digital culture for innovation and entrepreneurship. Nevertheless, as for many other activities, several bottom-up initiatives exist.

The digital infrastructure is planned, managed and continuously improved to align with the vision, mission and strategy of the innovative HEI

An HEI should integrate the design and organisation of its digital infrastructure to support innovation across all its activities. This includes for example the integration of its learning technologies and platforms, research and administrative systems, and supporting ICT services.

HEIs in Croatia are developing some forms of digital infrastructure. However, investments in this area could be strengthened. In addition, ethical and legal principle and standards related to digital aspects are not always considered in strategies and initiatives, also with regards to innovation and intellectual property rights.

The HEI is committed to digital teaching, learning and assessment practices

Digital technologies provide opportunities for innovative curriculum design and delivery, new pedagogies, learning processes and assessment methods. This fosters the development of digital competence and skills in staff and students, which are crucial today for every aspect of personal and professional development.

In Croatia, the extent to which digital technologies are integrated into study programmes varies from different HEIs and also different study programmes within the same HEIs.

Open science and innovation practices are widespread across the HEI

Open science improves the effectiveness, quality and productivity of a research system, encourages the adoption of new research methodologies and scales up innovation in HEIs (OECD 2015b, Dai et al. 2018). Through open science, the HEI promotes collaborative efforts, faster knowledge exchange, and new ways of sharing results (including publications, research data and methodologies) among students, staff and the society at large. In general, as in many OECD and EU countries, open science practices can be strengthened in Croatian HEIs.

The HEI has a dynamic digital presence supporting all its activities

An entrepreneurial HEI exploits the opportunities of digital technologies for communication, collaboration and networking. The HEI takes a coordinated approach to engage with its internal and external stakeholders, as well as to strengthen its international, national and local/regional outreach.

HEIs in Croatia exploit these opportunities although better digital communication and approaches appear to be a priority for students and staff as well as external stakeholders in many of the HEIs visited by the OECD team.

Knowledge exchange and collaboration¹⁵

Innovative and entrepreneurial HEIs do not operate in isolation but are strongly connected to other actors (e.g. companies – including both MNEs, large domestic firms and SMEs, other public and private research organisations, governmental agencies – national and local, such as regional development agencies or metropolitan authorities, cluster associations, technology and science parks, etc. OECD 2017a) of local, national and international innovation ecosystems. Knowledge exchange is an important catalyst for organisational innovation, the advancement of teaching and research, and local development. It is a continuous process which includes the so-called ‘third mission’ of an HEI, defined as the stimulation, direct application and exploitation of knowledge for the benefit of the social, cultural and economic development of society.

The HEI is committed to collaboration and knowledge exchange with industry, the public sector and society more broadly

Knowledge exchange is an important component of any innovative HEI. HEIs can develop support mechanisms for co-ordinating and sharing relationships across the HEI and give guidance on how to develop and implement all types of relationships with the public and private sector.

HEIs in Croatia exchange knowledge with relevant external actors in different ways (see Chapter 5), depending on the type of HEI and the surrounding eco-system. Many HEIs collaborate with local and national partners to adjust study programmes and organise internships although often in a non-systematic base but rather thanks to individual motivation. Research collaborations with companies are less developed also due to the lack of absorptive capacity of the Croatian domestic business sector and the low levels of business R&D in the country. Nevertheless, several effective partnerships between HEIs and local authorities exist, as in the case of the University of Dubrovnik, Rijeka or VERN¹⁵ for instance.

The HEI demonstrates active involvement in partnerships and relationships with a wide range of stakeholders

An innovative HEI understands the value of engaging with multiple stakeholders. There are many types of organisations with whom an HEI can form partnerships. These include, for example, regional and local governmental actors, quasi-public or private organisations, businesses (SMEs, large and international firms, social enterprises and entrepreneurs), schools and alumni.

As described in Chapter 5, several different channels for knowledge exchange are in place in the Croatian eco-system. However, these interactions could be strengthened for example by involving more external stakeholders in the work of the institution through governance, teaching, research, or support for student activities. External stakeholders could also be

¹⁵ This dimension is covered in detail in Chapter 5.

involved to a greater extent to provide monitoring and feedback on the effectiveness of different collaborations and partnerships.

An interesting example of an organisation facilitating knowledge exchange between the university and the surrounding eco-system is the University of Rijeka Foundation. The University of Rijeka has established in 2003 its Foundation (University of Rijeka Foundation) together with the City of Rijeka and the county of Primorsko-Goranska. This Foundation is one of the oldest University Foundation in Croatia (see Chapter 5). In addition to the Foundation, the University of Rijeka is actively working with the city authorities for the preparation of the Rijeka European capital of culture in 2020.

Knowledge exchange can also take place via teaching collaboration with a broad set of actors. For example, the Polytechnic of Velika Gorica has established partnerships with respect to teaching and learning with a variety of actors beyond the academia. These include several ICT and optometry companies (given its study programmes in optometry), the Ministry of Defence, the Ministry of Internal Affairs, the Croatian Red Cross, the Croatian Fire Brigade, the Mountain Rescue Service, the Croatian Armed Forces (with respect to its study programme on Crisis Management) and the Croatian Air Force and Defence as well as Croatian Airlines (with respect to its study programme on Aircraft Maintenance).

The HEI has strong links with incubators, science parks and other external initiatives

Several types of innovation infrastructure surrounding can provide opportunities to exchange knowledge and ideas with non-academic actors. These include, for example, incubators, technology transfer offices, science and technology parks, clusters, etc. Modern innovative HEI in most OECD and European countries have developed a system of such structures that allow both inward and outward flows of knowledge and ideas.

The eco-system of knowledge transfer organisations is currently at its initial stage in most Croatian HEIs. Many initiatives are being developed, however the level of activities remains very low (low number of companies in incubators, low number of patents, low number of spin-offs, etc.). As this eco-system of actors is at an initial stage, it is very important to make sure that Croatian HEIs learn from international experiences. In this respect, the establishment of a well-functioning and professionalised innovation agency with relevant funding programmes could be of great help in the Croatian eco-system (see Chapter 4 and 5).

The HEI provides opportunities for staff and students to take part in innovative interdisciplinary activities with the business sector and the external environment

An entrepreneurial and innovative HEI engages with the external environment through a variety of activities. These can range from informal activities, such as clubs and networking events, to more formal initiatives such as internships, collaborative research, industrial PhDs and entrepreneurship projects. Sometimes HEIs provide the physical space where these collaborations and experimentations can take place. HEIs can also organise events that encourage engagement with external stakeholders, such joint workshops, conferences and other networking events.

Many initiatives take place in Croatian HEIs, they are however often of small scale, fragmented and with little financial resources. In many cases collaborations and partnerships are driven by individual contacts and connections rather than by an

overarching knowledge exchange strategy. Two interesting examples have been developed by the University of Dubrovnik in two areas where the region has a clear comparative advantage. The J.J. Strossmayer University in Osijek has also developed interesting interdisciplinary approaches together with external stakeholders.

The HEI integrates research, education and knowledge exchange activities to absorb and exploit new knowledge

Effective relationships with the external environment often help stimulate the creation of new knowledge in every HEI. An innovative HEI should have mechanisms in place to integrate and absorb information and experiences from the wider innovation ecosystem, initiate dialogue and discussion between the HEI and the external environment, have clear mechanisms for exploiting entrepreneurial opportunities with commercial and industrial partners.

In Croatia, there are limited systematic mechanisms for HEIs to absorb knowledge from non-academic stakeholders. Most HEIs collaborate for the development of study programmes and internships but research and innovation partnerships are less developed. Academic patenting, spin-offs and start-ups are very low compared to HEIs in mature innovation eco-system and the overarching IP framework could be clarified (ownership between HEIs, faculties, researchers/students) to avoid possible future issues.

The Internationalised Institution

HEIs in Europe, OECD countries and beyond, increasingly compete and operate at the international level. For this reason they often integrate an international or global dimension into the design and delivery of education, research, and knowledge exchange. Internationalisation is not an end in itself, but a vehicle for change and improvement by learning from peers from other countries. International connections contribute to introduce alternative ways of thinking, questions traditional teaching and research methods, opens up governance and management to external international stakeholder, offer opportunities to exchange knowledge and collaborate with relevant partners (business, academia, public agencies, etc.) abroad. Therefore, it is linked very strongly to innovation and entrepreneurship.

Internationalisation is an integral part of the HEI's entrepreneurial agenda

An international perspective is a key characteristic of an entrepreneurial and innovative HEI. Most HEIs in OECD and EU countries have internationalisation strategies which ideally needs to be consistent with entrepreneurial and innovation agendas by aligning objectives and action plans.

HEIs in Croatia participate in European programmes. However, participation and success rates in EU programmes for research and innovation is not very high compared to EU averages (EU 2015, Horizon2020 First Results¹⁶). The internationalisation of Croatian HEIs could improve with respect to multiple dimensions: exchanges of students and staff, participation in international research projects, knowledge exchange with international

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https://ec.europa.eu/programmes/horizon2020/sites/horizon2020/files/horizon_2020_first_results.pdf

partners. Foreign students represent a very low share in most HEIs¹⁷ and often come from neighbouring countries such as Slovenia or Bosnia-Herzegovina.

Some HEIs have been very active and developed initiatives that could be replicated elsewhere. For example, as described in Chapter 5, the University of Rijeka has recently established (January 2018) an International Scientific Committee composed by international academics from German, Austrian, Slovenian, and American Universities (mostly connected to the Croatian diaspora) to help the HEI leadership to receive strategic advice on relevant international activities and benchmark the HEI against relevant international peer institutions. This Committee will also help define key performance indicators in the area of science and innovation. The University of Rijeka is also working to be integrated into the European University Network by 2024.

Other universities are also active, for example the University of Split has signed a number of bilateral agreements with foreign universities in the US, Europe, Japan and Russia.

The HEI explicitly supports the international mobility of its staff and students

International mobility brings in new education and research ideas, develop intercultural connections and long lasting partnerships (Appelt et al. 2015). In addition to attracting international staff and students, an innovative and entrepreneurial HEI actively encourages and supports the international mobility of its staff and students. It can promote, encourage and reward international mobility through exchange programmes, scholarships, fellowships and internships, for instance through European programmes.

Many Croatian students and researchers participate in European mobility programmes although incentive mechanisms do not necessarily exist at the HEI level. Many students look for internship opportunities in other European countries but often the only support in place is through HEIs offices for international cooperation but more comprehensive infrastructure is lacking.

The HEI seeks and attracts international and entrepreneurial staff

The internationalisation of an HEI depends upon people who can stimulate new approaches to teaching, learning, research and knowledge exchange in a global framework, using world-wide reputations and contacts to benefit the HEI's international network.

Given the sub-optimal framework conditions for entrepreneurship and innovation, many skilled and talented Croatians leave the country to seek for opportunities in more innovation and entrepreneurship friendly countries. It is therefore very important for Croatian HEIs to become able to attract more talented individuals from other countries: researchers, students, staff. At the same time, these networks of talented Croatians living abroad can be used to connect Croatian HEIs to the international diaspora. Countries that have been suffering from brain drain have developed platforms to connect domestic researchers with relevant individuals abroad. This was the case in countries as diverse as Ireland and Costa Rica.

It is not common for Croatian HEIs to attract international staff as most courses are taught in Croatian. It is not common to have specific international recruitment drivers in place or to have joint study programme with foreign HEIs. This is reflected to the low shares of international students and staff in most HEIs.

¹⁷ According to the data provided by HEIs receiving study visits

International perspectives are reflected in the HEI's approach to teaching

Access to new ideas for teaching and learning in the international environment can increase an HEI's ability to attract and retain talented individuals. Therefore an innovative HEI should have a teaching and learning environment tailored to a more global audience.

Language can be a barrier in this respect as most study programmes are in Croatian. In addition to that, joint or double degrees with institutions abroad are not very common. Many Croatian HEIs would benefit from more systematic benchmarking with similar HEIs in other countries, both in Europe and elsewhere, to acquire new knowledge and ideas of good practices implemented in other countries.

The international dimension is reflected in the HEI's approach to research

Strategic international research partnerships are an important part of an HEI's entrepreneurial and innovation agenda. The partnerships should be fully functional, not just on paper, and engage both staff and students.

The participation of Croatian HEIs in international research and innovation programmes can be strengthened. Many initiatives led by individual researchers or units are in place (for instance a well-known example is the School of Medicine in Rijeka that is particularly successful to attract EU research funding), but they would gain more impact if embedded into institutional or national internationalisation strategies for innovation and research.

Measuring Impact

Innovative HEIs need to understand the impact of the changes they introduce in their institution and in the wider ecosystem they operate in. Innovative and entrepreneurial HEIs combine institutional self-assessments, external evaluations and evidence-based approaches. However, impact assessment of innovation and entrepreneurship activities in HEIs remains underdeveloped. This is partly due to the fact that the currently available metrics used to assess impact typically focus on the quantity of spin-offs, the volume and quality of intellectual property and of the commercialisation of research results, but often tend to rely less on metrics related to teaching and learning outcomes, the attraction and retention of talent, the contribution to local economic development, graduate entrepreneurship, or the impact of the broader entrepreneurial and innovation agenda such as social and cultural dimensions. The reason is partly that even in advanced innovation-intensive countries, there is no consensus on the metrics to use to assess many of these initiatives. Due to the wide range of activities, there is no consensus about the timescale to use for measuring such impacts.

The HEI regularly assesses the impact of its innovation and entrepreneurial agenda

The impact of the innovation and entrepreneurial agenda can be wide ranging across research, education and knowledge exchange, as well as within the governance and leadership of the HEI. Understanding whether objectives are being met is crucial, if an HEI wants to progress and achieve its intended outcomes. HEIs that regularly review and assess the impact of their innovation and entrepreneurial agenda generally define clear intended outcomes related to their innovation entrepreneurial agenda, collect evidence of the outcomes of the entrepreneurial agenda and use this evidence as a tool for reflection and review of the strategy and mission of the institution.

Most HEIs in Croatia do not regularly assess their innovation and entrepreneurial agendas with the use of metrics and indicators. This is partly linked to the fact that there are no formal criteria for evaluating staff and students on the basis of innovation and entrepreneurship activities at the national or HEI level. However some efforts, coordinated by the Agency for Science and Higher Education are underway (see Chapter 5).

The HEI regularly assesses how its personnel and resources support its entrepreneurial agenda

Becoming an innovative and entrepreneurial institution may require an HEI to re-think how its personnel and resources are employed. An HEI may need to develop new human resource strategies, leverage external partnerships to overcome internal shortcomings, and secure new sources of financial support. HEIs could, for example undertake a skills/competence audit against the entrepreneurial agenda to assess its institutional development needs, use the information from the skills assessment and embed in recruitment strategies and staff performance appraisals, leverage external partners and resources to address any skills gaps, review and assess the success of the allocation of personnel and resources at regular intervals.

Given the lack of incentives at national level, it is difficult for Croatian HEIs to collect and use indicators in this area. Moreover, the existing barriers to the recruitment of personnel from the business sector or with non-academic background in some HEIs make such type of assessment challenging due to the lack of incentives at systemic level.

The HEI regularly assesses entrepreneurial teaching and learning across the institution

Ensuring that entrepreneurial and innovative teaching activities reach their full potential requires systematic assessment across all faculties and departments. An entrepreneurial HEI should develop clear objectives, which are regularly monitored and evaluated, and the results fed back into the renewal of study programmes and staff development.

Monitoring and evaluation of entrepreneurial teaching and learning is not a well-established practice in Croatian HEIs. The fragmentation of activities and lack of coordination across faculties may also hinder a coordinated monitoring and evaluation of such activities.

The HEI regularly assesses the impact of start-up support

It is important to monitor and evaluate start-up support activities to ensure that they are providing the appropriate quality of support in an effective manner. An entrepreneurial HEI should also monitor the outreach, take-up and role played by start-up/spin-off support across all faculties and departments.

Monitoring and evaluation of start-up support is not a well-established practice in Croatian HEIs. As already mentioned, start-up support is in a starting phase in many Croatian HEIs and, partly because of that, monitoring and evaluation practices have not been fully developed yet. It is nevertheless important to encourage HEIs to consider monitoring evaluation practices and methodologies to maximise the impact of the currently developed activities.

The HEI regularly assesses knowledge exchange and collaboration

Assessing and gaining a better understanding of the HEI's knowledge exchange and collaborative activities allow the HEI to gain a better idea of the type and the scope of collaborations with the external stakeholders and society. Therefore, an innovative HEI should have mechanisms and activities in place to regularly monitor and evaluate the intended outcomes and impacts of these activities across all faculties and departments.

Monitoring and evaluation of knowledge exchange activities of HEIs is not an easy task. The discussion on what metrics to use and what type of impact to capture is still on-going even in many innovation-intensive OECD countries. As already mentioned, knowledge exchange activities are not regularly evaluated in Croatian HEIs. This is an important area where Croatia can learn from relevant countries in Europe and the OECD (Chapter 5).

The HEI regularly assesses the institution's international activities in relation to its entrepreneurial agenda

Having an international perspective is a key characteristic of an innovative and entrepreneurial HEI. An innovative and entrepreneurial HEI should develop an internationalisation strategy and regularly monitor and evaluate whether this internationalisation strategy supports the development of its entrepreneurial agenda across all faculties and departments.

The internationalisation of Croatian HEI can be strengthened. As for other dimensions of innovative and entrepreneurial HEIs, monitoring and evaluation of internationalisation can be developed further. Moreover, this is an area where some types of indicators are easy to collect and generally available: such as number of international students, number of international staff, publications with foreign co-authors, participation in international projects, collaboration with partners abroad (research, business sector, others), etc.

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Chapter 3. Organisation capacity in Croatia: Funding, people, incentives¹⁸

This chapter looks at the second dimension of the HEinnovate framework “organisational capacity: funding, people and incentives”. It analyses Higher Education Institutions’ level of autonomy, human resource management policies, funding arrangements and academic career structures and examines the way these settings create opportunities for entrepreneurial and innovative activities. It also looks at the Croatian Strategy for Education Science and Technology (2014-2020) and the progress achieved in the implementation of objectives that relate to the organizational structure of HEIs. Finally, the chapter ends with some concluding remarks and provides recommendations that national government and HEIs could follow to improve the organizational settings of higher education institutions to scale-up innovative and entrepreneurial activities.

¹⁸ In the context of this report HEI refers to Croatian Universities, Polytechnics and Schools for professional higher education, but not to individual Faculties within a University.

This chapter concerns the second dimension of the HEInnovate framework, “Organisational Capacity: Funding, People and Incentives”. According to the HEInnovate framework “The organisational capacity of an HEI drives its ability to deliver on its strategy. If an HEI is committed to carrying out entrepreneurial activities to support its strategic objectives, then key resources such as funding and investments, people, expertise and knowledge, and incentive systems need to be in place to sustain and grow its capacity for entrepreneurship.”

Chapter 1 reports the situation in Croatian higher education in terms of this dimension and the various issues it encompasses. The Croatian higher education faces challenges in several areas (such as sustainable funding, internal synergies, entrepreneurial staff recruitment, staff development and incentives) as well as in the area of the strength of institutional leadership, particularly in non-integrated and semi-integrated universities.

The purpose of this chapter is to analyse why these challenges exist and what needs to be done to address them at the level of system and institutional level policies. The two chapters that follow focus on the other two HEInnovate dimensions selected by the Ministry of Science and Education: “Preparing and supporting entrepreneurs”; and “Knowledge exchange and collaboration”.

This chapter takes a broad view of innovation as set out by HEInnovate in Box 3.1. This broad view of innovation is also evident in the work and focus of the European Consortium of Innovative Universities (ECIU) that is Europe’s leading “club” of innovative universities.¹⁹ The ECIU view on innovation is set out in Box 3.2.

Box 3.1. Innovation and entrepreneurship in Higher Education Institutions

The HEI is a driving force for entrepreneurship and innovation in regional, social and community development. HEIs can be a force for social transformation. They can be a major employer in a locality and their existence will impact on the local economy and social wellbeing. The objective of an entrepreneurial and innovative higher education institution in research, teaching, industrial and community collaboration is the improvement of society and the quality of life.

Entrepreneurial HEI plays a key role in the local entrepreneurial ecosystem and demonstrates strong presence in the community. This might include, for example:

- Providing facilities to others from outside the institution;
- Participating in regional clusters;
- Supporting local cultural and artistic activities;
- Providing opportunities for regional start-ups or established companies, and
- Taking an active role in determining the strategic direction of local development.

Source : heinnovate.eu

¹⁹ This is not to say that all of Europe’s top-performing innovative universities are members: ECIU wishes to remain a small (ca. 15 member) consortium and to have no more than one member per country.

Box 3.2. The European Consortium of Innovative Universities (ECIU)²⁰

When the consortium was founded in 1997, member universities were the “new kids on the block”. The name European Consortium of Innovative Universities underlines the European dimension of a selected group of entrepreneurial universities dedicated to the development of an innovative culture in their institutions, and to a catalytic role for innovation in industry and society at large. Whilst many consortia today are innovation based, ECIU member institutions were pioneers in pursuing an innovation agenda.

In the last 20 years, ECIU has grown into a consortium with mutual trust and networking and collaboration across academic and administrative areas in all member institutions. ECIU has gained a collective wealth of experience and expertise in innovative education, research, knowledge exchange and administrative structures and practices. It offers a pool of resources e.g. in the field of teaching entrepreneurship; in promoting entrepreneurship amongst students and staff; and in treading new roads in the collaboration with business, industry and the public sector which provides a sound basis for the ECIU’s various activities. ECIU membership is a vehicle for maintaining a competitive edge, allowing members to learn from each other and to take forward activities that individual institutions could not pursue on their own. Externally, the ECIU provides a collective, more powerful voice with greater impact than individual institutions engaging in European public debate on their own.

The universities in ECIU are united by a common profile, by shared beliefs and interests and mutual trust:

- All ECIU universities have strengths in engineering and social sciences.
- All are relatively young, either in age or spirit, and strongly committed to the encouragement of innovation and entrepreneurship.
- All have very close ties to industry and to their regions.
- All are committed to developing unconventional forms of teaching and learning.
- All are research intensive.
- All wish to sustain and nurture internationally minded staff.
- All are determined to offer their students high quality education with an international focus.
- All experiment with new forms of management and administration.
- All wish to play a significant role in European policy making by contributing to Europe’s agenda for Higher Education.

Source: <https://www.eciu.org/>

²⁰ ECIU members are Aalborg University; Dublin City University; Hamburg University of Technology; Kaunas University of Technology; Linköping University; Tampere University of Technology; Tecnológico de Monterrey; The University of Nottingham; Universitat Autònoma de Barcelona; University of Aveiro; University of Stavanger; University of Trento; and University of Twente.

Before starting an analysis of the features of the Croatian system, the next sections focus on a typology of policy or steering instruments that can be used by governments and institutional leadership to steer their higher education system and institutions; and a theoretical perspective on the importance of institutional diversity in successful mass higher education systems and the challenges of achieving this.

Analytical perspectives on the organisational capacity of HEIs

The issues covered by the dimension “Organisational capacity” are clearly impacted by issues included in the HEInnovate first dimension “Leadership and Governance”. “Strong leadership and good governance are essential to developing an entrepreneurial and innovative culture within an HEI”. In turn, institutional leadership and governance are strongly impacted by the national higher education policy environment in which they are embedded.

The following typology of policy instruments based on the work of Hood (1983, 2007) and Howlett (2009) constitutes a useful basis for describing the policy instruments that are used or might be used by the Croatian government and university leadership to promote innovation and entrepreneurship:

- *Information* (the use of information and communication)
- *Regulation* (laws, regulations etc.)
- *Funding* (positive and negative financial incentives)
- *Organisation* (the use of experts, networks, infrastructure, agencies etc.)

The second analytical framework relevant for this chapter concerns institutional diversity in higher education systems. As used in biology and ecology, diversity refers to the variety of types and/or the dispersion of entities across those types. Literally applied to higher education this would mean the different types of institutions (universities, technical universities, universities of applied sciences, colleges...) and the distribution of institutions and students across these types. Recently many higher education systems in European and OECD countries have given policy attention to creating a diversity of institutional profiles within the same formal institutional type – different programme mixes, research focus areas and differing intensity of involvement in regional engagement, knowledge transfer, internationalisation etc. (see, for example, the institutional profiles of U-Multirank, <https://www.umultirank.org/>).

The question of diversity of institutional profiles is also important when it comes to innovation and entrepreneurship. HEInnovate is not promoting an innovative and entrepreneurial profile as a new “gold standard” for all higher education institutions. In Croatia, as in all higher education systems, institutions vary in terms of how innovative and entrepreneurial they aspire to be and in the nature of the innovative and entrepreneurial activities they undertake. This variation is influenced by many factors including institutional missions, geographical location and the fields of study they are engaged in (business studies and engineering are more naturally innovative and entrepreneurial than theoretical physics and medieval history).

Thus, to take an example from an innovation-intensive country, the Dutch higher education system would arguably be less successful if all of its research universities had the same entrepreneurial profile as the University of Twente. The key points are that systems should

have diverse policy instruments that encourage different institutional profiles and that support and reward institutions that opt for a significant focus on innovation and entrepreneurship in their missions and strategies (OECD 2018a).

Institutional diversity is seen as a key response to the spread of higher education (Trow, 1974), a sector which in many countries now enrolls more than 50% of the relevant age cohort. Diversity has been shown to provide more social mobility through multiple modes of entry and forms of transfer; access for a wider variety of students; to better meet the diverse needs of the labour market; to be a condition for regional specialisation; and to increase the effectiveness of higher education institutions through institutional specialisation.

In an important analysis, Van Vught (1996, 54) put forward two propositions about diversity: the larger the uniformity of the environmental conditions of higher education organisations, the lower the level of diversity of the higher education system; and the larger the influence of academic norms and values in higher education organisations, the lower the level of diversity of the higher education system. International experience suggests that successful diversified higher educational systems require diversified systems of governance, funding, human resource management, quality assurance and accreditation, and performance evaluation (thus diverse, not uniform environmental conditions).

Included in Table 3.1 are some examples of differentiated policy approaches that may be appropriate to institutions with diverse missions, including the ones in Croatia. The following section will return to these two analytical frameworks later in this chapter.

Table 3.1. Examples of differentiated policy approaches for diverse institutions

| Policy domain | University of Applied Sciences | Regionally orientated university | Research-intensive university |
|--|---|---|---|
| Primary mission | Career-focused 1st cycle programmes closely linked to local labour market needs. Third mission linked to local labour market and community development. | Regionally relevant 1st and 2nd cycle programmes and selective 3 rd cycle & research strengths. Third mission linked to regional development. | Internationally competitive research, PhDs and research Masters. Third mission linked to knowledge exchange in leading edge RD&I. |
| External members of governing board | Key local employers Major secondary schools | Key regional economic sectors Senior regional/local officials | International researchers Large knowledge intensive companies |
| Funding | Basic core funding (input & output) Teaching and learning development grants Competitive funding for practice-based applied research; Third-stream income. | Basic core funding (input and output) Teaching and learning development grants; Competitive funding for research and applied research; Competitive national research funding | Basic core funding (input and output) Competitive national and international research funding Third stream income. |

| | Third-stream income. | | |
|--|---|--|--|
| Human resources | Institutionally developed, flexible academic workload policies that vary by individual (and over a career) and cover the major activities of the institution. A career structure that provides for career development and progression based on transparent criteria linked to individual work profiles and performance. | | |
| Institutional evaluation & performance criteria | Graduates and employment Local impact Practice-based applied research results | Graduates and employment Regional impact (Applied) research performance | Graduates and employment Research performance PhDs produced External research income generated International peer review |
| Programme accreditation criteria | Designed in partnership with local industry Including work placements Staff with relevant work experience Facilities for project-based learning | Institutional capacity relevant to the programme Regional relevance (but not exclusively) | Institutional (research) capacity relevant to the programme National and international relevance |

Source: Developed by Jon File for the European Commission DG R&I Peer Review of Polish Higher Education and Science (2017). Specific Polish references removed or modified.

Systemic constraints on innovation and entrepreneurship in the Croatian higher education system

Major pre-conditions for successful innovation and entrepreneurship in higher education are systemic policies and steering instruments that promote, facilitate and reward innovation. Despite the intentions set out in the Croatian Strategy for Education, Science and Technology 2014 – 20 (see section below), the Croatian higher education policy environment does not appear to be currently a strongly conducive environment for innovation.

There were many excellent examples of innovation in the eight higher education institutions visited by the OECD delegation. The institutional visits included meetings with groups of academic staff and groups of students engaged in innovative and entrepreneurial activities. However, in all cases, they reported to be the exception rather than the rule - less than 10% of people actively involved in innovative and entrepreneurial activities was a common estimate (VERN' was an exception with higher involvement). The major obstacle is that innovative activities are not adequately supported, recognised and rewarded institutionally. Excellent innovation happens because of the enthusiasm and commitment of individual staff and students (and often in their own time). As one interviewee put it, "The risk is that enthusiasm is a fuel that burns fast".

The lack of adequate institutional support, recognition and reward is not primarily the result of a dearth of institutional commitment, interest or capacity but is a symptom of a systemic

policy environment that is not conducive to the development of such policies and systems at the institutional level. Important aspects of the Croatian higher education system that in the OECD team's view have a significant constraining impact on the innovative and entrepreneurial capacity of Croatia's higher education institutions include the following issues.

Autonomy and accountability of HEIs

In terms of higher education governance, the trend in Europe's most successful higher education systems (e.g. Scandinavia, Switzerland, the Netherlands) over the past decade has been, generally speaking, in the direction of more institutional autonomy (and accountability); the increasing representation of external stakeholders on the senior institutional governing body; the final selection of the head of the institution by this body; the strengthening of the powers and responsibilities of the institutional head; and the reduction of the powers of representative bodies of internal stakeholders. It is also not a coincidence that most of the ECIU member universities have leadership and governance systems that are in line with these trends. These reforms have also been strongly promoted by the European Commission for over a decade (Box 3.3).

Box 3.3. Ensuring real autonomy and accountability for HEIs, the EU modernisation agenda

HEIs will not become innovative and responsive to change unless they are given real autonomy and accountability. EU Member States should guide the university sector as a whole through a framework of general rules, policy objectives, funding mechanisms and incentives for education, research and innovation activities. In return for being freed from overregulation and micro-management, universities should accept full *institutional* accountability to society at large for their results.

This requires new internal governance systems based on strategic priorities and on professional management of human resources, investment and administrative procedures. It also requires universities to overcome their fragmentation into faculties, departments, laboratories and administrative units and to target their efforts collectively on institutional priorities for research, teaching and services. EU Member States should build up and reward management and leadership capacity within universities. This could be done by setting up national bodies dedicated to university management and leadership training, which could learn from those already existing.

Source: European Commission, Delivering on the modernisation agenda for universities: education, research and innovation, COM(2006) 208 final, p 5

While Croatia is not alone in Europe in not moving in this direction, there is a growing consensus among higher education governance experts – researchers and experienced leaders – that successful higher education institutions are most effectively lead and managed in the model outlined above or variants of it (although this is not hard evidence based, or politically accepted in many systems). Croatian higher education governance is characterised by low levels of external stakeholder involvement; the election of Rectors and Deans by stakeholders within the institution from professors within the institution; and the strong powers held by representative bodies of these stakeholders.

Although the Croatian Act on Scientific Activity and Higher Education grants higher education institutions a high level of autonomy on paper, the 2017 EUA University Autonomy in Europe report paints a different picture. Croatia rated 18th of 29 European systems on organisational autonomy, 15th on financial autonomy, 29th on staffing autonomy and 21st on academic autonomy. As the report argues, “In order to be successful, universities need to be able to take their own decisions.” (<https://www.university-autonomy.eu/>).

Non-integrated and integrated universities

In Croatia, integrated universities are those where faculties are not autonomous legal entities but a constituent organisational sector of the university; non-integrated universities are composed of autonomous faculties with independent legal status.

Although only four out of 49 Croatian higher education institutions (public & private) fall into the second category, they account for some 70% of the students, a similar proportion of academic staff and 80% of Croatian Web of Science articles (2013 – 17). Therefore, they constitute the major component of the Croatian higher education and research system. The debate about integration has been an intense one that has lasted for many years and many other reports already highlighted the existing issues. For example:

“The HEI sector is also characterised by a great deal of institutional complexity. The four older universities (Zagreb, Split, J.J. Strossmayer in Osijek and Rijeka) are divided into faculties and academies, which are set up as separate legal entities and possess considerable autonomy. Such within-institute legal fragmentation is uncommon today, and the universities established over the last decade do not possess this fragmented set-up. However, because the HEI sector has resisted attempts to reform, the government, when managing the sector’s governance, budgeting, planning, external quality assurance, etc., must deal with 122 separate actors rather than 55 HEIs” (OECD 2013).

A recurring finding, also in line with the findings of this report, has been that autonomous faculties, directly funded by government, are a major inhibitor of effective central university leadership; institutional strategy and profiling; priority setting; flexible resource allocation that responds to changing needs and priorities; efficient structuring of professional and other support services; and inter-disciplinary teaching and research programmes. This is not to argue that non-integration renders all of this impossible but to contend that it makes creating these important institutional capacities much more of a difficult and time-consuming task than it would be in an integrated institution – a conclusion shared by the leadership of the universities, visited in the context of this Review.

Public funding levels and mechanisms

Croatia currently spends 0.73% of GDP on higher education, which is significantly below the EU median of 1.4%. The funding allocation method is a complex one as indicated in Box 3.4.

Box 3.4. Institutional funding of Croatian HEIs

The latest reform of the institutional funding system in Croatia has been introducing contract-based funding, using both input-based and output/performance-based criteria. In this context, a new development for the academic year 2012/2013 has been the introduction of a pilot-scheme of funding agreements (or “contract funding” according to the categorisation by Jongbloed et al., 2010) between the state and higher education institutions. These agreements introduce for the first time a transparent input-based component, as well as an output/performance component, allowing institutions to receive additional funding for meeting specific public policy objectives. The core components of this latest funding system are the following:

- **Base funding:** base funding for higher education institutions remains a combination of incremental funding and negotiated funding.
- **Input-based supplement to base funding:** in addition to base funding, each higher education institution receives additional funds through tuition fee subsidies to fully cover the costs of all full-time students entering their first year of studies (undergraduate or graduate) and of all full-time students who progress through each academic year with more than 55 ECTS points. The subsidy is provided at a national fixed-rate of 3,650 HRK/485 EUR per student.
- **Performance-based funding:** within the pilot funding agreements, each higher education institution agrees on performance targets with the Ministry among a list of priority areas set by the Ministry. Higher education institutions receive these funds if they achieve certain targets measured by set indicators within the three-year term period of the agreement (from the academic year 2012/2013 to 2014/2015). Performance-based funds are calculated as 10% of the total amount that each higher education institution receives as tuition fee subsidies (as described above), and not as a percentage of base funding or total funding.
- The ACCESS project report (see source below) estimates that input-based supplemental funding will represent around 10% of the overall public funding received by higher education institutions, and that funding allocated on the basis of performance will be around 1% of overall funding. Although of limited magnitude, and although the funding system is still dominated by incremental/negotiated base funding, the introduction of these new mechanisms represents a significant step in itself in changing the dominant paradigm of incremental and negotiated funding in Croatia.

Source: Jon File et al. Higher education funding and the social dimension in Croatia, 2013, ACCESS project report, IDE, Zagreb p29

Participation in the pilot programme contract arrangement was optional: seven of the eight public universities did so as did 10 polytechnics and schools of professional higher education. The programme contracts cover all three of the funding components. The priority areas set by the Ministry as mandatory goals for performance-based funding were

related to teaching (degrees on time, increasing STEM graduates, programme learning outcomes and increased access (such as low socio-economic status, disability and over 25s). Other goals that could be selected by institutions included:

- Improve the relevance of student evaluation of teachers and teaching;
- Increase the quality of work of administrative support and services in HEIs;
- Increase the amount of student scientific work;
- Internationalization of higher education;
- Improve cooperation between students and management of higher education institutions;
- Increase cooperation with other higher education institutions;
- Increase co-operation with the economy and the local community on issues of interest to students, studies and teaching;
- Increase the quality of teaching;
- Any other objective aligned with the strategic guidelines of the higher education institution.

A second round of performance agreements was signed for the period from academic year 2015/2016 to academic year 2017/2018 with the following goals: ensure equal access to higher education to all full-time students; encourage successful studying; any other objective aligned with the strategic guidelines of the higher education institution.

The new performance agreements will run for four years from the 2018/2019 academic year and will cover all non-salary components of public funding to higher education institutions. Crucially the agreements are signed between the Ministry and the universities in the four non-integrated universities, which gives central university leadership potentially more influence on strategy, priorities and the provision of central support services including in the area of innovation and entrepreneurship²¹.

The introduction of a performance based component in the overall funding system is a significant step and has introduced a new steering instrument into the Croatian higher education system that could be expanded in scope as public expenditure on higher education increases as planned in the period to 2020. It could also be extended to other important policy priorities including innovation. Performance agreements are also potentially valuable policy instruments for promoting institutional diversity if used skilfully (Box 3.5).

²¹ Information on performance agreements in this section was provided by MSE

Box 3.5. The rationale and benefits of performance agreements

Performance agreements can have the following aims (only the first aim which is the most relevant to institutional diversity is included here):

To encourage institutions to strategically position themselves. This is also known as *institutional profiling*. Performance agreements are expected to contribute to establishing a diversified higher education system - the bilateral nature of the agreements should enable this.

This aim – to use performance agreements to establish or maintain a diversified higher education system – is found in a number of countries (e.g. Austria, Ireland, Germany, Finland and the Netherlands). The virtue of a diversified higher education system is a well-recognised goal. Performance agreements are thought of as fitting this goal well. The Austrian *Wissenschaftsrat* concluded that such agreements do contribute to a more diversified Austrian higher education landscape. Experiences from other countries however reveal that this is not by definition the case. The Finnish case shows that performance agreements (and the performance-based funding models attached) have indeed stimulated institutional profiling, but at the same time this has not led to a more diversified system. From Germany it is possible to learn that, because institutions must respond to the same issues, the agreements may have led to homogeneity instead of heterogeneity at the system level.

Source: Harry de Boer et al. 2015, Performance-based funding and performance agreements in fourteen higher education systems. Report for the Dutch Ministry of Education, Culture and Science, CHEPS, pp 13 - 14

National academic career structures and human resource management

Croatia has a national system of academic career structures with three types of careers: scientific; scientific-teaching; and teaching. The basics of the system are set out in Box 3.6.

Box 3.6. Academic career structure in Croatia

The teaching staff of university higher education institutions have to be appointed to scientific-teaching grades. Scientific-teaching grades are Assistant professor, Associate professor, Full professor and Full professor with tenure. The conditions for the appointment to scientific grades are a PhD degree and an appropriate number of published papers (varying by field and seniority). A scientific grade is acquired on the basis of a national procedure (application for promotion or the advertisement of a scientific-teaching position). The process involves expert committees, expert boards and scientific field committees.

The conditions for the appointment to scientific-teaching grade are: appropriate scientific grade, adequate number of teaching hours, papers co-authored by students, experience in supervising, professional development, publication of teaching materials and textbooks, introduction of new teaching methods, membership in editorial boards of journals, editorship of conference proceedings, project leadership experience, reviewer experience, invited lecturer experience, etc. Other than the scientific grade, the other assessments are internal matters for the higher education institution but within criteria set by the Rector's Conference.

Although polytechnic staff can apply for scientific grades most are on the teaching grades of Lecturer, Senior Lecturer, College professor and College professor with tenure. This is based on the policy that polytechnic academic staff have primarily a teaching function that is reflected in the teaching hours regulations where they are required to teach a minimum of 450 hours per year compared to 300 hours for their university counterparts.

Source: Edited version of section 8 of Higher Education in the Republic of Croatia, ASHE, 2018

Note: There are also a number of other grades in artistic fields and language teaching

From the perspective of promoting innovation and entrepreneurship, it is notable that none of the three tracks recognises the performance of such activities as legitimate contributions to the criteria determining progress in academic careers. This reality underlies the frequently voiced concern of academic staff involved in innovative activities that these are not recognised or rewarded.

In Table 3.1 on differentiated policies for diverse institutions, the human resource policy suggested is common for all three of the institutions used as examples:

“Institutionally developed, flexible academic workload policies that vary by individual (and over a career) and cover the major activities of the institution. A career structure that provides for career development and progression based on transparent criteria linked to individual work profiles and performance”.

The rationale for this approach is that human resource policies need to be appropriate to the mission of the institution and to recognise that individuals should contribute in different and not standard ways to the achievement of the institution's goals given their different interests and skills. These decisions are best taken at the institutional level (by faculties and departments within a central institutional policy framework) in terms of national

regulations that prevent excessive workloads and the exploitation of staff. For institutions that see innovation and entrepreneurship as a key element of their missions this allows staff active in this area to be recognised and rewarded in terms of their work portfolios and academic careers.

Such an approach is very different to a system based on standard national teaching load regulations. There are two major disadvantages to such regulations: on one end of the spectrum, a leading researcher who became the principal investigator of a major Horizon 2020 project would still be required to teach 300 hours a year; at the other end, academic staff who are not research-active and haven't published anything in years are only required to teach 300 hours when the polytechnic example suggests 450 hours is more like a full-time teaching work load.

Both the national career structures and teaching loads are an indication of a human resource management system that is underdeveloped in Croatian higher education. The situation as regards the professional development of academic staff is described in Box 3.7. Two further examples are given in the Croatian strategy for education, science and technology 2014 – 20: a lack of teaching and learning training for academic staff; and few opportunities for life-long learning for administrative staff.

Box 3.7. Academic staff development in Croatia

The science and higher education system in Croatia is characterised by the absence of systematic, institutionally supported practice regarding the university teachers' professional development in all the (core) academic activities. The competency profile would enable the planning and organisation of the university teachers' development in accordance with the defined competencies required for their work. Furthermore, the existence of the competency profile indicates a need for the permanent “culture of learning” at the Croatian universities through the monitoring of the current trends and changes within the profession, thus providing better individual, as well as institutional results and achievements.

Source: APROFRAME, 2017, Recommendations on the academic profession competencies and the professional socialisation of junior researchers, p 3.

An underdeveloped professional higher education sector

In Croatia, 29% of students are enrolled in professional higher education programmes. 61% of these students are enrolled in polytechnics and schools of professional higher education and 39% in universities. The role of universities in professional programmes (40% of students in university professional programmes are formally part-time and so pay tuition fees) has been the subject of intense debate for some time (Box 3.8).

Box 3.8. Introducing and strengthening the non-university sector in Croatia

Croatia was one of 12 countries selected as a case study in the 2016 DG EAC study on structural higher education reforms. The case study focused on the establishment of non-university higher education institutions in Croatia from the mid-1990s and the government's attempts to gradually make these institutions the sole providers of professional study programmes, which implied gradually phasing out such programmes in the university sector. These horizontal differentiation reforms aimed at enhancing higher education's contribution to the regionally balanced development of Croatia as a knowledge society by increasing the quality, efficiency and accessibility of higher education. The policy instruments employed were changes in system level legislation and the introduction of procedures and criteria for the accreditation of institutions and programmes, with no changes in state funding mechanisms. The reform achieved part of its operational goals through the establishment of non-university institutions and somewhat decreasing the number of students enrolled in professional programmes at universities. However, the reform has failed to align types of programmes with types of institutions so the binary divide remains blurred.

Source: Jon File et al. Structural Higher Education Reform – Design and Evaluation, DG EAC, Brussels (2016, p24)

Compared to a number of other European countries (for example, over 60% in the Netherlands), 29% is a relatively modest enrolment and it is unclear how many of the programmes are professional career-focused programmes with the characteristics outlined in Box 3.9, particularly those offered in the university sector. In addition it appears that the Croatian higher education policy environment is insufficiently diverse to support a strong polytechnic and college sector with a distinct and different mission. Once again, Box 3.9 gives some good practice indications of such an environment.

Box 3.9. A vision for professional higher education

Career-focused (or polytechnic) education (CFE) should consist primarily of short- and first-cycle programmes, where:

- the “curriculum design logic” is to prepare students for a career in a field of employment
- the curriculum is designed in consultation with relevant employer groups/professions
- a substantial part of the programme is taught by staff who have had direct working experience in the field
- a significant component of work integrated learning is included
- the curriculum is offered by a programme team that is active in applied research and development in the field.

Career-focused education is likely to thrive in a differentiated policy environment with the following characteristics:

- Academic values are balanced by employer expectations
- Mission appropriate governance (external stakeholders)
- Mission appropriate accreditation and quality assurance
- Mission appropriate HRM/career structures
- Mission appropriate institutional and individual performance expectations
- Task related funding allocation model
- Balance between CFE and non-CFE programmes is carefully steered
- Substantial public funding is earmarked for applied research and development
- High levels of public and labour-market understanding of and support for CFE

Source: Jon File: Presentation on the Development of Effective Polytechnic Policies, Lisbon Research and Policy Workshop, Museu das Comunicações, 16 October 2007

The size and effectiveness of the polytechnic (in particular) and college sectors are of direct relevance to innovation and entrepreneurship. To take the Dutch example (see Box 3.10), over the past 15 years the universities of applied sciences have developed considerable capacity in the area of practice-oriented research which has contributed significantly to innovation and entrepreneurship with regional industry and the public sector. The Dutch UAS sector meets most of the criteria in Box 3.9 which means that applied research and development in partnership with business and industry is a natural part of its mission and builds on links established in its educational activities, particularly joint curriculum development and student placements. Having a relatively small and less distinctly profiled sector means that Croatia has less capacity for this type of innovation and entrepreneurship.

Box 3.10. The Netherlands – Strengthening research in Universities of Applied Science

At the turn of the millennium, this horizontal differentiation reform—the establishment and institutionalisation of a research function as the second core task of the Dutch universities of applied sciences (hogescholen) - was introduced to contribute to the strengthening of the innovative capacity of the Netherlands by the optimal use of the UAS sector in delivering highly-skilled modern graduates and services needed by regional industry and the public sector.

For these purposes the UAS research base had to be strengthened. Several policy instruments were introduced to strengthen the UAS research function by means of the introduction of new staff positions, grants for practice-oriented research and grants for the establishment of Centres of Expertise. In the fifteen years since the first steps were taken the stronger research orientation of UAS institutions has achieved a structural and indispensable position in Dutch higher education. In this respect, the structural reform has been successful in changing the Dutch higher education landscape.

Source: OECD/EU (2018), Supporting Entrepreneurship and Innovation in Higher Education in The Netherlands, OECD Skills Studies, OECD Publishing, Paris/EU, Brussels, <https://doi.org/10.1787/9789264292048-en>.

Croatian strategy for education, science and technology 2014 – 20

The Croatian parliament adopted this important and comprehensive strategy on October 17 2014. The Ministry of Science and Education was the coordinating institution for developing the strategy but two different boards and many “sub-boards” were responsible for the content. The first board was a national coordination board, with the prime minister and different ministers as members while the second board was the operational board chaired by the special science advisor of the prime minister and including stakeholders from science, higher education, primary and secondary education, parliament and other institutions.²²

The strategy’s chapter on higher education recognises many of the systemic constraints discussed above. The most important strategic objectives for the purposes of this chapter are the following (there are eight strategic higher education objectives with 81 associated measures – actions to be undertaken by designated bodies and organisations, and a further six objectives for science and technology):

Objective 2: establish an efficient binary higher education system that is aligned with national needs and with the principle of efficient management of higher education institutions

The action plans include developing a new management model for higher education institutions to mitigate the problems associated with independent faculties (and making the legislative changes required to do this); the new model may include external stakeholder management boards and a new method of appointing Rectors and Deans; to strengthen the polytechnic and professional school sector’s profile and rebalance its student mix which is

²² Note: the Croatian government changed in 2015.

currently social science dominated – particularly business and economics (see Box 3.11 for an example of a programme to strengthen the polytechnics in Portugal); and to extend the pilot programme agreement funding system to a new “full scale” system of programme agreement funding of higher education.

Box 3.11. Strengthening the Portuguese Polytechnic sector

One important initiative by the Portuguese Ministry is helping to renew and update the binary divide. In 2015, the Ministry established the Programme for the Modernisation and Valorisation of the Polytechnic Sector, which aims to improve the public perception of the sector and to modernise the model of polytechnic higher education and applied research using the most advanced and successful experiences in Europe and the United States. One important element of the programme is a budget of EUR 17.5 million to fund the first Portuguese Research Council call for financial support of practice-based R&D activities in consortia of polytechnics, launched in May 2016.

The programme’s focus on the development of modern methods of career-orientated teaching and learning is being driven through linkages, study tours and joint programmes with European and United States systems with strong university of applied science or college sectors. Visits of polytechnic leaders to Finland and Switzerland took place in 2016 and missions to the Netherlands and Ireland took place in 2017. A call for joint programmes between Portuguese polytechnics and their equivalents in these countries was launched in 2017.

Source: Information supplied by Professor Eduardo Beira, Programme Coordinator

Objective 3: Ensure a high-quality human resource structure at higher education institutions as a foundation for improving the quality of higher education

The HR action plans include reforming the appointment procedures and criteria for academic staff who should be appointed by institutions on the basis of peer review. This entails maintaining the idea of minimum research criteria for teaching/research staff at different grades (with modifications) set by the National Council for Science, Higher Education and Technological Development but moving from the Rector’s Conference national criteria for minimum teaching experience to institutions developing their own criteria to assess the quality of applicant’s teaching. The strategy recognises that these criteria will vary according to the missions and focus areas of each institution.

The strategy recognises that the current task and workload structure for academic staff does not reflect the changing nature of academic work. It proposes a new four-segment task and workload model (teaching; research; organisational, management and professional work in academic bodies; and involvement in the third mission - focused on “the development and improvement of economic, cultural and civil life”). The ratio of each activity will be based on the missions and focus areas of each type of institution and will allow institutions to modify these and to add additional activities in line with their strategic focus. A new system of evaluating the performance of academic staff across the different activities will be developed.

Objective 4: Develop an efficient higher education funding system that stimulates development

The intention is to move to a system of funding based fully on programme agreements (performance agreements) that will include “EU models of good practice” in input and output based funding criteria as well as project-based funding. The mechanisms of funding and contracting will vary by institutional type. Institutions will have greater autonomy to allocate funds as a precondition for more efficient management. The strategy proposes to increase public expenditure on higher education from the current 0.73% of GDP to the EU median level of 1.4% by 2020 as “such low expenditure prevents any serious reform”.

The strategy aims to develop an integrated higher education funding system that takes into account national priorities and links them to quality assurance and to the achievement of the strategic goals of higher education institutions so a link will be made between the results of quality assessment and the funding of higher education institutions through the programme agreements.

It is now four years since the strategy was adopted by the Croatian parliament and 2020 is a little over a year away. In Croatia a number of interviewees observed that “Croatia is good at strategy but not at implementing strategies”. In terms of the three key objectives outlined above, there is no concrete evidence of significant progress in strengthening the binary system nor of a new management model for the non-integrated and semi-integrated universities. There has also not been a reform of the academic career structure, nor a broadening of recognised academic tasks and the workload model. In terms of a more efficient funding model that stimulates development, the programme agreement system (see the description earlier in this chapter) has the potential to do this as it now encompasses all public funding to higher education institutions other than salaries and the agreement is entered into with institutional central management and not the faculties. The impact of the latter on internal resource allocation is not yet clear.

One area where there has been a welcome development in terms of innovation and entrepreneurship is in the standards developed by ASHE for the new round of institutional re-accreditation. Standard 5.2 in Box 3.12 below now refers explicitly to activities in these fields, so once the new round is completed ASHE will have a much fuller picture of what is actually taking place in this regard in Croatian higher education institutions.

Box 3.12. ASHE standard 5.2

The newly introduced standard 5.2 states as follows:

“The higher education institution provides evidence for the social relevance of its scientific / artistic / professional research and transfer of knowledge”. Elements of the standard include:

The higher education institution monitors and takes into consideration the needs of society and labour market in planning its research activities;

The higher education institution has an efficient support system for research and transfer of knowledge and technologies;

Teachers and associates participate in the activities of scientific, arts and professional organisations.

Evidence gathered during the site-visit and indicators from Croatian HEIs show the existence of:

Examples of scientific/technological cooperation with the industry and public sector in the application of knowledge and transfer of technology;

Examples of innovations, patents;

Examples of measures for encouraging the development of start-ups and spin-offs;

Involvement in science and technology parks and business incubators;

List of patents, reports, uses of expertise;

List of publications in professional journals.

Source: Standards for the evaluation of quality of universities in the procedure of re-accreditation of higher education institutions, Undated, ASHE (edited)

Organisational capacity: conclusions and policy recommendations

As indicated at the beginning of this chapter, the issues covered by the dimension “Organisational Capacity” are clearly impacted by issues included in the HEInnovate first dimension “Leadership and Governance”. “Strong leadership and good governance are essential to developing an entrepreneurial and innovative culture within an HEI”. In turn, institutional leadership and governance are strongly impacted by the national higher education policy environment in which they are embedded. As argued earlier, university and polytechnic leadership is structurally weak with limited steering power given the election of Rectors and Deans from professors within the institutions and the high levels of autonomy of faculties in the semi-integrated and non-integrated universities. This together with resource constraints means that in cases where leadership is highly committed to innovation it is very difficult to embed this in the institutional culture.

System level policy

In terms of system-level policies, a number of factors other than leadership and management have a significant constraining impact on the innovative and entrepreneurial capacity of Croatia's higher education institutions. These include public funding levels and mechanisms; national academic career structures and workloads, and relatively basic human resource policies in general; and an underdeveloped professional higher education sector. In summary:

- *Funding and resources:* Croatian higher education is underfunded and what funding there is for innovation and entrepreneurship tends to be sporadic and project based which is not a sustainable basis for the long-term development of these activities.
- *Relationships and synergies:* universities with autonomous faculties makes the creation of strong internal relationships and the achievement of synergies a larger challenge than it is in integrated higher education institutions. As indicated earlier, this does not mean that this is impossible to achieve.
- *Recruiting innovative individuals:* many Croatian higher education institutions engage innovative individuals from business and industry as part-time or sessional teaching staff. In terms of full-time academic staff, universities can recruit innovative individuals but only if they have a PhD – the polytechnics have more flexibility as the PhD is not a requirement for posts other than college professors. Having said this, the OECD review team saw little evidence that innovation is a serious criterion in the selection of staff.
- *Staff development:* As indicated earlier, the human resource management function is in general underdeveloped in Croatian higher education. This applies to academic staff development as indicated in the APROFRAME recommendations as well as to professional support staff as mentioned in the strategy document. The review team argued earlier that good practice in this regard is “institutionally developed, flexible academic workload policies that vary by individual (and over a career) and cover the major activities of the institution. A career structure that provides for career development and progression based on transparent criteria linked to individual work profiles and performance” (see Table 3.1). Such policies are also promoted within the HEInnovate framework and would allow for innovation and entrepreneurship to be recognised as a legitimate part of the work portfolios of staff active in these areas.
- *Incentives and rewards:* the most frequently mentioned reason for relatively low levels of innovation and entrepreneurial activity in Croatian higher education is the lack of incentives and rewards for those undertaking such activities. These fall outside of the current criteria for academic career progression although the strategy document suggests that these criteria should be broadened. If this challenge is not met, there is likely to be a continuation of the current situation where innovation is fuelled by enthusiasm and undertaken by only a small minority of academic staff.

Analytical frameworks: policy instruments and institutional diversity

Policy instruments. The analytical frameworks introduced at the beginning of this chapter distinguished between four broad types of policy instruments: information (the use of information and communication); regulation (laws, regulations etc.); funding (positive and

negative financial incentives); and organisation (the use of experts, networks, infrastructure, agencies etc.). Both at the system level (steering institutions) and at the institutional level (steering departments and individuals) we see a limited range of policy instruments that are not applied diversely enough. The major policy instruments in Croatian higher education are funding and incentives; human resource management; institutional evaluation and performance criteria; and programme accreditation criteria. None of the current policy instruments promotes innovation and entrepreneurship. Programme agreements have the potential to do so, as do the broader ASHE criteria for institutional re-accreditation. The latter will provide a wealth of data on innovation in Croatian higher education and this information should be communicated creatively so that institutions performing strongly are publicly recognised.

On funding and incentives, Chapter 5 makes the case for the national policy level to place knowledge exchange activities central in funding and policy instruments; for the creation of longer term funding dedicated to knowledge exchange at the institutional level; and for the development of clear incentives for knowledge exchange activities both at the national higher education policy level and the individual institutional level.

Institutional diversity: As indicated in the previous paragraph, Croatia does not have sufficiently diverse environmental conditions within its binary higher education sector. Funding, human resource management and institutional evaluation criteria could be more distinct across the sectors. While there are considerable differences within the university sector in terms of institutional size, programme mix and geographical location there is far less diversity of missions. A primary reason for this is that the funding mechanisms do not encourage different institutions to develop their own distinctive missions and profiles and their own desired mix of teaching, research, professional work and third-mission activities. This reflects a sector that is dominated by academic norms and values given the central role of professors in the sector at all levels of leadership and in powerful representative internal governance bodies.

Policy recommendations

This section highlights two major recommendations for reforming Croatian higher education that can have a significant impact on the effectiveness of the system and will have the potential to create a policy environment that is conducive to the promotion of innovative and entrepreneurial activities. Box 3.13 identifies three critical factors that affect the success of major reform processes in higher education.

Box 3.13. Critical factors affecting the success of structural reform processes

In the 2016 DG EAC structural reform study referred to earlier, the (12) case studies and cross-case analyses enabled the identification of five critical factors (only the 3 most relevant to this chapter are included here) affecting the success of structural reform processes that appear to have a *potentially* crucial influence on the final achievement and effects of the reform. These factors are neither necessary conditions for success (they do not all apply to all structural reforms) nor sufficient conditions (reforms can fail for other reasons).

1. Stakeholders' involvement and consensus. The implementation of the reform was smoother and its operational goals were achieved in cases in which key stakeholders were involved in the design of the reform and/or consensus was built between the stakeholders about policy problems and solutions (the latter may not always be realistic.)

2. Adequate funding and funding instruments. Reforms tend to work more effectively when there is adequate financial support given the scope of the reform and which allows a sustained effort over a realistic time frame.

3. Construction, to the extent possible, of a 'win-win' reform design. In an ideal situation, all higher education institutions should have something to gain from the reform or at least believe that they will not be disadvantaged.

Source: Jon File et al. Structural Higher Education Reform – Design and Evaluation, DG EAC, Brussels (2016, p6).

The process by which the Croatian strategy for education, science and technology 2014 – 20 was developed did include key stakeholders and that there was a broad agreement that this represented a promising way forward for Croatian higher education. The strategy also envisaged a significant increase in public funding for higher education that is a very important ingredient for successful reform. New resources also create the potential for a “win-win” reform where all sectors and institutions can benefit from resources allocated for different purposes – for example to support innovation and entrepreneurship. This is in contrast to the issue of professional programmes at universities, which if transferred to polytechnics (which would clarify the binary system) would result in universities losing students and revenue. A smart reform would ensure that the universities would benefit in other ways from the new resources injected into the system.

Two overarching policy recommendation follow. These are prerequisites for a well-functioning system conducive to entrepreneurship and innovation.

Implement Objectives 2, 3 and 4 of the 2014-20 Strategy for education, science and technology

The higher education objectives of the Croatian strategy for education, science and technology 2014 – 20 *should be implemented*. The three key objectives from the perspective of this chapter are:

Objective 2: establish an efficient binary higher education system that is aligned with national needs and with the principle of efficient management of higher education institutions

Objective 3: Ensure a high-quality human resource structure at higher education institutions as a foundation for improving the quality of higher education

Objective 4: Develop an efficient higher education funding system that stimulates development

The action plans linked to these objectives have been outlined earlier in this chapter, but in essence, they encompass a broad range of funding, governance and human resource management reforms, all of which would *inter alia* enhance the capacity of Croatia's higher education institutions to engage in innovative and entrepreneurial activities.

Increase public investment in higher education, while at the same time promoting institutional diversity and central strategic capacity of HEIs

The strategy proposes to increase public expenditure on higher education from the current 0.73% of GDP to the EU median level of 1.4% by 2020 as “such low expenditure prevents any serious reform”. While the 2020 target may have been too optimistic, *Croatia needs to increase its public investment in higher education significantly*. The programme contracts provide a useful framework within which to do this in such a way that institutional diversity is promoted and that the role of central leadership in non-integrated and semi-integrated universities is strengthened by the allocation of a strategic budget to the Rectorate with a view to developing the institutional capacities mentioned earlier: institutional strategy and profiling; priority setting; flexible resource allocation that responds to changing needs and priorities; efficient structuring of professional and other support services; and interdisciplinary teaching and research programmes. The programme contracts should also provide for both long-term and project funding for innovation and entrepreneurship.

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Chapter 4. Preparing and supporting entrepreneurs in the Croatian Higher Education System²³

This chapter examines how Higher Education Institutions support entrepreneurial activities within their institutions in Croatia. It looks at on-going efforts HEIs have recently put in place such as entrepreneurship learning courses across faculties, mentoring programmes, internship partnerships, student business plan competitions, start-up support centres and incubators. The chapter also assesses how spin-offs and technology transfer operations are handled by HEIs. Finally, the chapter ends with some concluding remarks and a few policy recommendations to help the national government and HEIs level-up their support to entrepreneurs.

²³ In the context of this report HEI refers to Croatian Universities, Polytechnics and Schools for professional higher education, but not to individual Faculties within a University.

HEIs can play an important role to boost innovation and entrepreneurship

One of the eight dimensions of the HEInnovate framework (Chapter 2) is “Preparing and Supporting Entrepreneurs” by HEIs. Strengthening HEIs in this area is particularly relevant for Croatia to educate students and researchers as entrepreneurial innovators and agents of change. In the HEInnovate framework, entrepreneurial education and behaviour is not aimed solely at starting new business but also at stimulating an entrepreneurial and innovative mind-set that students can apply when being employed in an incumbent organization.

It is important to remember, however, that framework conditions conducive to entrepreneurship and innovation are essential to promote the ability of individuals (including students and researchers) in a country to start-up and grow a business or becoming an entrepreneurial employee. Traditional indicators measuring innovation and entrepreneurship show that Croatia lags behind peer countries (Chapter 1). These framework conditions should always be considered when addressing the issues related to HEIs and the role they can play to promote innovation and entrepreneurship (Box 4.1).

Box 4.14. Framework conditions for entrepreneurship and innovation in Croatia – a prerequisite for preparing and supporting entrepreneurs

Some key frameworks conditions for innovative entrepreneurship in Croatia

Innovation and entrepreneurship are key drivers for economic growth through their impact on productivity and competitiveness and are crucial for Croatia to catch up with comparable countries in the EU and beyond. In Croatia, R&D as % GDP in 2016 was 0.84% and is still far from its 1.4% Europe 2020 target. Scarce public investment but also the fragmented landscape of HEIs, and HEIs' lack of international competitiveness leads to low performance in scientific outputs (European Commission, 2018). BERD as % of GDP is below EU-28 average and stagnating. Most of the private business sector R&D is concentrated in few large multinational and domestic companies: PLIVA, Erikson Nicola Tesla, Podravka and Koncar-Electrical Engineering Institute.

An analysis of firm entry and exit shows the lack of dynamism of the economy and entrepreneurship. In Croatia, only 5.5 percent of all firms were new to the market every year over the period 2008–12; in ECA (Europe and Central Asia) peers such as Bulgaria, Hungary, Romania, the rate was 9–18 percent.

Croatia also lags behind on firm exit: 6.5 percent versus 7–26 percent in ECA peers. When we look at net entry rates (entry minus exit), Croatia presented negative values, indicating that exit outpaced entry over 2008–12, reinforcing the view that Croatia's economy is characterised by reduced creative destruction and innovation. Also the high-growth firm (gazelle) rate lag behind peer countries (World Bank, 2015).

The 2017/2018 Global Entrepreneurship Monitor Report (GEM) reports that the TEA-Total Entrepreneurship Activity defined as the percentage of the adult population who are in the process of starting a business or started a business less than 42 months old- is in Croatia on par with the Europe (8.9% versus 8.1%). However the motivation index (defined as the ratio between improvement opportunity driven TEA and necessity driven TEA) is 1.2 in Croatia versus 3.4 as average score in Europe. Necessity driven TEA refers to businesses started out of necessity because lack of other options while improvement driven TEA is initiated when seeking independence and increase in income through an own company. GEM data also show a low score on Entrepreneurial Framework conditions in particular government regulations, entrepreneurship education and a culture and norms that support entrepreneurship. On the last one Croatia scores lowest of all 54 participating countries.

An additional and essential factor in driving innovation and competitiveness is Foreign Direct Investment (FDI). Inward FDI reflects the activities of foreign multinationals, including the acquisition of stakes in domestic firms. The existing literature supports the view that inward R&D-intensive FDI constitutes a powerful mechanism of international technology transfer which can enable host locations to develop specialized clusters and integrate more advantageously in global value chains (OECD 2008, Global Forum on International Investment; Government strategies to attract R&D intensive R&D). FDI can be an important channel for local technology transfer and spill overs can spur innovation activities of local firms either directly, e.g. by integration into global production chains and the transfer of knowledge through co-operation and labour mobility, or indirectly, for instance as a by-product of increased competition.

There is a considerable amount of empirical evidence on the incidence of spillovers to the host economy from FDI and with the maturing of the national innovation system of spillovers from local innovative companies to foreign investors (Athreye and Cantwell, 2007). Among OECD countries, Israel is a well-known example of the latter case. Initial foreign direct investments by companies like Motorola and Intel were guided by the availability of good and cost-effective engineering talent. But over time technology and management knowledge spillovers resulted in a fast growth of startups. The majority of these startups were acquired by MNEs to strengthen their technology and product portfolio thereby creating a second cycle of FDI in Israel. Presently Israel counts over 307 multinational R&D centers employing 71 000 individuals, a quarter of the country's tech workforce (Dun and Bradstreet 2017).

Over the last decade inward FDI stocks increased considerably in Croatia (OECD 2019). However, in Croatia FDI remains concentrated in non-tradable sectors such as financial intermediation and tourism, which unlike manufacturing, present little opportunity for knowledge spillovers. HEIs are often strongly connected to FDI attraction. They could and should play a key role in entrepreneurship and innovation education, in technology transfer and product innovation and in changing the cultural perception regarding entrepreneurship.

Entrepreneurial universities, start-ups and spin-offs: some definitions

The emergence of the “entrepreneurial university” gave universities a dual mandate to produce new knowledge but also to broaden its activities and values in such a way as to facilitate the transfer of technology and knowledge spillovers and to educate individuals to build and strive in an entrepreneurial society as entrepreneurs and innovators (Audretsch 2014). Studies on student entrepreneurship and technology transfer from universities distinguish between *startups-student* entrepreneurs and *university spinoffs (USOs) – academic entrepreneurs*. Student startups are often small local service businesses with moderate growth and funding needs but could also be more technology intensive product/service companies based on knowledge acquired through education, internships and mentoring by staff and industry experts.

The startups created by academic staff and researchers are commonly called university spinoffs (USOs) aimed at transferring specific knowledge originated at the HEI. In Croatia, there is no clear national legal or regulatory framework covering intellectual property and technology-commercialization property rights, nor are there clear guidelines or legal framework for USOs created by scientist. Several universities, nevertheless, are developing their own guidelines for intellectual property rights (World Bank 2015).

Both student startups and USOs have received ample attention by regional and national policy makers as creators of employment and in the case of spinoffs as growth drivers for new industries. Equally important is the support of innovation in existing industry by HEIs and the education of innovators who can act as internal entrepreneurs (often called intrapreneurs) in particular in the case of Croatia where innovation in local industry is lagging.

While there are a number of common and overlapping elements and characteristics in startup student entrepreneurs, spinoff- academic entrepreneurs and innovators-intrapreneurs there are also important differences.

Student startups are sometimes initiated by students who are entrepreneurial by nature and would start their own business anyhow. But mostly, these startups emerge during a

students' entrepreneurial journey facilitated by the HEI, starting with an awareness/education/inspiration phase through formal courses and/or extracurricular events. These include lectures by role models followed by an action-learning/experimenting phase by those students who have an idea and want to validate their idea and entrepreneurial intentions. This is mostly done through a project course assignment or participation in student competitions or internships. When the student is sufficiently motivated this second phase is followed by a startup/business building phase. The support needed in the startup phase is quite different than that for the inspiration and action learning phases, in terms of mentoring, professional services, space and access to networks. Entrepreneurial HEIs are developing eco-systems for student startups to develop this diversified support (Wright, Siegel and Mustar 2017).

University spinoffs (USOs) provide academic entrepreneurs with an alternative pathway for applying and commercializing research instead of collaborative research, consultancy, publications or licensing. The typical journey of HEI spinoffs starts with an invention of a university researcher (including research students). That invention is reported as an invention disclosure. The HEI may decide to file IP for this invention. Often at this stage the invention is a technology solution looking for a problem and it is very different from regular startups that look for solutions for a problem. The HEI and researcher could decide to license the invention to a company or to license the invention to a USO to commercialize the invention. The subject of spin-off creation has received substantial attention in the literature and policy circles. Often, the resources and tools needed for student startups and research spinoffs are the same with additional support through a TTO network and research funding (Boh, de Haan, Strom 2015).

The indirect impact of university spinoffs could be more significant than the direct result of job and wealth creation. The entrepreneurial process of opportunity discovering both by faculty members and their research students for uses of research in the real world to achieve direct societal impact can bridge the gap between the conservatism of academic research and use-inspired research (European Commission 2017). In particular in the Croatian context it can help HEIs to manage and streamline their R&D activities towards societal needs and commercial goals and by doing so link with companies early in the research life cycle.

A third class of entrepreneurs that can be prepared and supported in HEIs are **Intrapreneurs-Innovators**. These are partly those students who embarked on the startup entrepreneurial journey, got inspired, experimented with ideas to start a company, gained an entrepreneurial mindset but decided not to pursue a startup because either the business idea was not convincing enough or the economic and personal risks were deemed too high at this point in time of their life. But they also include students who have no intentions to start a company but may be interested in the Innovator/Intrapreneurs role as product builders, designers, change agents in incumbent companies. For those students not only entrepreneurship courses but also design-thinking, product development, innovation and change management courses are important.

Entrepreneurship education at HEIs is aimed at providing students with additional skills to proactively and effectively apply their knowledge, with as an exceptional outcome the development of a student startup during their studies. Problem based learning courses typically taught as part of the entrepreneurship curriculum can be tailored to educating intrapreneurs and innovators through innovation projects in the traditional industry. A famous example of this type of education is offered at Technion-Israel (Box 4.2).

Box 4.2. Project-based innovation learning from traditional industry at the Technion-Israel Institute for Technology

At Technion-Israel Institute of Technology, programmes have been developed where industrial engineering and management students promote innovation in traditional industries, as part of their final year projects of their higher education studies.

Mission:

The Knowledge Center for Innovation at the Technion – Israel Institute of Technology, together with the Israel Innovation Authority and the Council for Higher Education (under Israel Ministry of Education) have joined forces to promote technological and business innovation in the traditional industry sector of Israel, and introduce engineering students to the industry through their final year capstone projects.

Rationnel:

As part of research done by interviewing 162 CEOs of SME companies in the northern part of Israel, it was observed that 50% of company CEOs spend less than 5% of their time on innovation, and only 5% of the CEOs spend 20% of their time or more, on innovation.

The programme:

As part of the programme, students at their fourth and final year of their Industrial Engineering and Management studies participate in a project aimed at uncovering challenges and weakness spots, analysing the causes and coming up with innovative ways to address them. Students bring a clean and fresh mindset, go beyond existing paradigms and therefore can bring new ideas on possible ways of addressing challenges.

It is also an opportunity for the companies to recruit young and capable students who tend to prefer the well-known high – tech employers as default.

Several academic institutions take part in this unique program, across all of Israel, including the most prestigious universities in Israel as well as new established colleges at the periphery of Israel.

Accomplishments:

During the past 7 years over 170 students and over 50 companies have participated in the program from various sectors – metal, plastics, agriculture, printing, chemicals and many more.

Source: adapted from Technion Israel Institute of Technology (2014), Knowledge Centre for Innovation, Knowledge Transfer section, “Seeds of Innovation”, www.innovation.technion.ac.il/mobile/traininginfo.aspx?catid=15&id=68, accessed in April 2019

On-going efforts in Croatia HEIs, analysis and findings

This section presents a general analysis on the support of entrepreneurship at HEIs visited, followed by an analysis of mechanisms for student startups, university spinoffs.

General support of entrepreneurship activities in Croatian HEIs

Entrepreneurial universities encourage engagement with the surrounding community, care about impact of research, consider entrepreneurship and innovation as an important skill set for all its students and promote student start-ups and university spinoffs. Entrepreneurial universities have a number of common characteristics highlighted below.

A visible and shared vision and objectives towards entrepreneurship and innovation

Except one, none of the HEIs visited mentioned entrepreneurship and innovation on its website. Entrepreneurship is generally not mentioned in the strategic action plans of universities. Students interviewed were not fully aware of entrepreneurship initiatives nor were business partners in the community. All HEIs provided entrepreneurship courses, none had specific targets for percentages of students to attend those courses and most courses were provided only to students in economics and business.

Support and leverage bottom-up initiatives by staff and students by providing resources and leadership to sustain these activities and to create economies of scale and scope

The HEIs showed a wide variety of bottom-up initiatives by professors, teachers and students. However the governance structure of the semi and non- integrated universities and the fragmentation of resources and initiatives, amplified, in many cases, by the absence of a university centre of gravity for entrepreneurship and innovation hinders leveraging these activities and the offering of supporting resources across the university.

In most Croatian HEIs visited, a centre of expertise was located in the faculty of economics and business not always appreciated by other faculties and de facto mostly limited to economics-business students despite the fact that in most cases entrepreneurship courses are open to students of all faculties. Except for the University J.J. Strossmayer in Osijek (Box 4.4), none of the HEIs had an entrepreneurship centre with expertise and accountability reporting to a senior member in university's management, with the tasks to initiate, stimulate, coordinate, promote and brand entrepreneurship and innovation activities.

Many universities in leading OECD countries nowadays have such an entrepreneurship centre (e.g. Martin Trust Centre at MIT (Box 4.3), Bronica Entrepreneurship Centre at Technion) sometimes centralized but often organised following a "hub and spoke" setup in which faculties/departments are independent in the pursue of entrepreneurial content. The entrepreneurship centre coordinates, provides and disseminate knowledge, provides funding for selected activities and exhibits a coherent brand and positioning of the university's entrepreneurial ecosystem.

Box 4.3. The MIT Martin Trust Centre for Entrepreneurship

The Martin Trust Centre for MIT Entrepreneurship provides the expertise, support, and connections MIT students may need to become successful entrepreneurs. The Centre serves all MIT students, across all schools, across all disciplines.

As reported on its website, the Trust Centre Values are :

- *MIT standard of excellence and rigor*: the Centre provides the highest-quality education, advising, and practical experiences;
- *Collaboration*: the Centre works closely with other MIT departments, labs, centres, and groups to connect students with the best entrepreneurship programming across the Institute, and beyond when appropriate;
- *Diversity*: entrepreneurship requires diversity of opinion and diversity of people. Throughout the courses, advising, and programming, the Centre combines a range of critical perspectives;
- *Experimentation*: each year the Centre develops new programmes and activities. If students fail, they learn. The Centre staff don't expect everything to work the first time; if it all does, it means the Centre is not innovating enough;
- *Honest broker*: neither the Centre nor its faculty or staff are allowed to take a financial interest in any of the new companies that the Centre nurtures and assists. The Centre provides students with multiple options and educate them on the process to make an informed decision. The choice always rests with the student and the Centre works to create a level playing field for the possible different options. The Centre only goal is the student's entrepreneurship education and long-term entrepreneurial success;
- *Mens et Manus*: consistently with MIT's motto, in all courses and throughout different activities, the Centre operates on a hybrid model that combines academic and practitioner perspectives.

Source: adapted from <http://entrepreneurship.mit.edu/mission>

Box 4.4. The International Centre for Entrepreneurial Studies (ICES) at the J.J. Strossmayer University in Osijek

The International Centre for Entrepreneurial Studies (ICES) at the J.J. Strossmayer University in Osijek emerged from intensive research activities in the field of entrepreneurship, from the late 1980s. A research team led by Professor Slavica Singer started to survey entrepreneurial paradigms in contrast with mainstream management theories. From 2002 they lead the Global Entrepreneurship Monitor survey in Croatia. Intensive research activities focused on entrepreneurial phenomena indicated education as a major missing link in closing the gap between problems Croatia was (and still is) facing (unemployment, decreasing development strength, increasing poverty) and needed enterprising energy to deal with such problems (proactiveness, innovativeness in defining and solving problems, responsibility for own choices). It was a starting point for looking for the best practices around the world in providing education for entrepreneurial competences.

Very early the decision was made about the major (ideal) features of the educational program(s) which were planned to be established at the J.J. Strossmayer University in Osijek: (1) to have a program based on experiential learning, not just few isolated courses; (2) to use best practices around the world in order to develop curricula, new teaching methodology, own faculty, and to build international structure of faculty and students; (3) to offer such program across campus; (4) to work toward replacing such programme by embedding knowledge and skills about entrepreneurial competences in every single course across campus.

Using experience from Durham Business School (Prof. Allan Gibb), St Paul University (Prof. Jerome Katz), Turku School of Economics (Prof. Antti Paasio) and many others a hub of entrepreneurial educational programmes (from undergraduate to doctoral level) was developed in the period from 2000 to 2010. Ten years after starting the master degree programme in entrepreneurship at the Faculty of Economics in Osijek, the doctoral programme on the university level was offered in 2010. The establishment of the doctoral programme is also the result of an EU funded project (2009-10) of five partnering universities (Durham University, Turku School of Economics, University of Klagenfur, University of Maribor, J.J. Strossmayer University).

ICES managed to fulfil the first three envisioned mission listed above. However, the level at which entrepreneurial education could be embedded in all courses across campus still needs improvement.

Lessons learned

Bottom up changes are possible, but they are less demanding and faster to implement when supported by the leadership and governance of the HEI. Learning by doing is always needed, especially when working on projects with long term impact. If needed, the departures from the original ideas should be considered, but not at the cost of being lost in the maze of compromises.

Source: Box provided by Professor Slavica Singer

Entrepreneurial universities encourage students to initiate and lead entrepreneurial activities

Entrepreneurial activities take place in many HEIs in Croatia. Examples are hackathons occurring in most HEIs visited, the eSTUDENT association and the Racing Team at university of Zagreb. In some cases credit points are given for these extra-curricular activities. A university centre of entrepreneurship could further stimulate such students activities across campus. Some HEIs in OECD countries have allowed students to take a proactive role in the definition and design of entrepreneurship related activities (Box 4.5).

Box 4.5 Student driven business competitions, the case of BIZTEC at the Technion-Israel Institute of Technology

In 2004 students at the Faculty of Computer Science started BizTEC, a national Technion student led business competition.

BizTEC is open to current students and recent graduates from all academic institutions in Israel, working on ventures with a focus on deep technologies. BizTEC provides a thriving learning environment with an extensive network of partners and mentors, and, in some cases, financial grants to help starting entrepreneurs get off the ground. Over a six-month course, BizTEC provides entrepreneurs with the knowhow to test their ideas, develop coherent business models, and launch companies. About 100 teams apply each year for the Inspiration and Registration stage during the winter semester. Guided by workshops candidates evaluate their idea for a startup and fill out the application form. About 25 teams are selected by industry judges to move forward to the next stage: the e-School stage.

During the spring semester five tailor-made workshops are given to help developing a business model and write an executive summary. At the end of this stage teams present to a judging panel and about 10 teams are accepted to the BizTEC pre-accelerator. During this stage teams get a dedicated mentor and weekly meetings with experts. The final event is a Demo day for a large audience of the Israeli tech ecosystem and the winning team receives a USD 10 000 award. More than 50 BizTEC companies have become active businesses that raised USD 350 million. The strength of BizTEC and key factor of its success is that it is student driven. The programme marketing, content and fund- raising, is done by a team of students and offers them a great learning experience. The role of the Technion Entrepreneurship Centre is to provide coaching and facilities only. A BizTEC management team typically serves two BizTEC competitions until their graduation and is responsible for selecting and handover to their successors.

Box provided by the author of this chapter. Content adapted from Biztec (2019), www.biztec.org.il, accessed in April 2019

Entrepreneurial Universities provide action learning courses across faculties

With the emergence of entrepreneurship and innovation education at universities a few decennia ago, business schools “took ownership” of this type of education. But since then other types of tertiary education schools such as engineering schools see creativity and innovation, design thinking, entrepreneurial outlook and communication skills as essential

skills for engineers. These are often taught in problem based project courses. Similar skills are needed to be taught at social sciences and art faculties to prepare for self-employment and innovator roles to reposition their profession within the larger fast changing society context. This is for example the case of the entrepreneurship courses in department of Journalism at VERN' Polytechnic.

Most students do not opt for an entrepreneurship career at least not immediately on graduation. For instance only 6.9% at Velika Gorica Polytechnic intended to start their own business upon graduation but that number increased to 36% for those 5 years after graduation and as many as 55% of the graduated students stated that the atmosphere in Velika Gorica gave them the motivation to develop ideas for a new business. Student in HEIs should be exposed to the first phases in the entrepreneurial journey: inspiration and awareness of entrepreneurship and innovation and experiment in idea creation, communication and team-work and learning by doing.

The content of courses in these phases is not about starting a company but on opportunity discovery, design thinking, product/service design, team work and communication skills as well as learning how to be an innovator and intrapreneur. Inter-disciplinary and across faculty courses are the most effective and enriching ones with the highest probability to result in a startup or out of the box innovations (Box 4.6). Examples of such across faculty courses are rare in Croatian HEIs. A possible explanation is that the fragmented HEI governance model and the lack of a coordinating mechanism are an obstacle to the development of such types of classes.

Box 4.6. Cutting-edge entrepreneurship education, examples from Cornell Tech

Cornell Tech and the Jacobs Technion-Cornell Institute, established in 2012 in New York City, focuses on creating technology leaders for the digital age through research, technology commercialization and graduate level education.

The Studio Programme

The Cornell Tech Master education programmes in engineering, business administration, operations research and law offer students technical depth in their chosen disciplines, which is crucial to advancing the digital age. But the Studio program adds another education layer and is comprised of intense, immersive interdisciplinary team experiences that provide all Master students with hands-on, real world skills that challenge and expand their roles in their chosen fields. The Studio Programme, driven by project-based, cross-functional collaborations, covers one third of the Master programme's curriculum and is a joint and mandatory programme for all Master students.

Cornell Tech's Studio Curriculum is anchored in two major courses: Product Studio, in which mixed student teams develop a product or service in response to a strategic business challenge posed by a real company, followed by the Start-up Studio class in the second semester, in which mixed student teams develop their own start-up idea. A challenge facing typical capstone project courses prevalent in entrepreneurship education is that these education projects may evolve into the founding of a real start-up often without upfront arrangements with team members and the university on IP and clarity on boundaries between university and commercial activities. In the Studio programme, in order to align student teams' expectations upfront, all students sign a Cornell Standard Project Agreement for Student Collaborations.

The goal of this agreement is to make it easy for students to collaborate on projects for academic credit in a manner that will enable the IP created through this collaboration to be used by students outside the academic partnership, for example, in a commercial context after they graduate from school. Studio teams that decide to transform their Studio project into a start-up will be supported by Cornell Tech but only after their graduation.

Runway start-up post doc programme

The vision in creating the Runway start-up postdoc programme by the Jacobs Institute was to establish an effective, additional model for commercialising academic research and to offer an alternative postdoctoral and career option for PhD graduates. Up to six postdocs per year are selected as a cohort to make during a period of one –two years the paradigm shift from an academic mind-set to an entrepreneurial one through business education, experts' support, initial funding and the entrepreneurial eco-system of Cornell Tech and the City of New York.

Runway developed a new IP founder-friendly framework in which the Jacobs Institute grants: a royalty free, exclusive, perpetual and transferable license to all IP developed by the postdoc company. Runway provides a package of benefits valued for the first year at US 175 000. In exchange the Runway postdoc companies issue to the Jacobs Institute a security note for same amount which will be converted to equity in the first equity funding round. The programme started in 2014. Since then, 20 postdocs have been enrolled, 43% US citizens. All have incorporated and 15 Runway companies are active and raised over USD 35 million funds. Runway is about getting companies started that would not otherwise

get started and about “crossing the valley of death” of risky, deep technologies and about making impact outside academia. Runway is not a traditional university incubator but an innovative postdoc programme encouraging and supporting application of academic research.

Box provided by the author of this chapter.

Entrepreneurial universities are engaged with their community (both business/industry and society) through activities as joint research and consultancy, internships by students, project courses, guest and adjunct lecturers, mentors, advisory boards, joint incubation space

All HEIs visited are engaged with their surrounding community. Most students are from the area and find employment in the area. The university engagement with its community provides the base for an entrepreneurship ecosystem in terms of professional support, mentoring and incubation space and support. Examples of community engagement are:

- **Internships in all HEIs, in some cases mandatory.** The University of Split developed the concept of Teaching Base. The Teaching Base has established agreements with partner organisations. These agreements state that part of the teaching and learning can take place in that organization/business entity. Mentors of the teaching base can also be mentors of future entrepreneurs in the pre-incubation period. So far 145 teaching base agreements have been signed. This is a promising example of educating innovators/intrapreneurs;
- Three universities (in Split, Rijeka, Osijek) **have business/industry involved in choosing the research subject for master students** and allow students to have a **business supervisor** in addition to academic supervisor resulting in a direct transfer of knowledge;
- All research universities in the sample have developed **joint projects with the industry.**

Student start-ups

When preparing and supporting student start-up entrepreneurs, four stages in the entrepreneurial journey can be identified. Each stage provides educational value for the student and after each stage the student may decide to drop out:

- The first stage is the one of awareness of the importance of entrepreneurship and innovation, of the inspiration and the fun/self-actualization of entrepreneurship and innovation and is the stage of basic education in entrepreneurship. Ideally all HEI students should be exposed to this first stage;
- The second stage is for those students that are inspired by the first phase and would like to experiment and try out some ideas in a project based course or a competition and test their entrepreneurial intentions and motivation;
- The third stage is for those students who have an idea, want to start a company but need networking, other resources and support, to be provided by the HEI often in cooperation with the local eco-system;

- The fourth stage is for those students who have founded a company, crossed the HEI boundary but would benefit from support by the university and local ecosystem. This stage is in particular relevant for university spinoffs.

All elements of this start-up funnel are in place in all HEIs visited in different degrees but in general are small in scale and narrow in scope involving a few motivated individuals only (Table 4.1).

Table 4.1. Student start-up stages

Examples of good practices from Croatian HEIs

| Stage | Some good practices observed, applicable to all HEIs in Croatia |
|--|--|
| <p>1. Awareness, education, inspiration</p> | <p>In all HEIs visited basic courses in Entrepreneurship are provided, mostly by the economics faculty.</p> <p>A workgroup at the University of Zagreb is developing an entrepreneurship curriculum. The courses are open to all students but the number of students of other faculties attending is low.</p> <p>At University of Rijeka 50% of economics students take entrepreneurship courses but few of other faculties.</p> <p>At Polytechnic Velika Gorica most students take a basic course in entrepreneurship customized for faculties and mandatory for optometry students and in groups of max 30 students.</p> <p>Polytechnic VERN' has many part-time teachers from the business sector or non-academic organisations who have to follow a two week teacher training course. The tutorial, small class (25) and interactive style at VERN' encourages student curiosity and out-of-box teaching. Entrepreneurial skills and mindset make VERN' graduates highly employable. VERN' offers a course in design thinking for students and faculty</p> |
| <p>2. Action learning, experimenting</p> | <p>Croatia offers a wide variety of case study and business plan competitions and hackatons in which students are encouraged to participate and winners are offered a place in incubators.</p> <p>A three days bootcamp at the University of Rijeka sponsored by the US embassy is considered a success.</p> |

At Polytechnic Velika Gorica students are stimulated to participate in competitions and will get credits, winners get scholarships.

At Polytechnic VERN' once a month a failed and a successful entrepreneur presents its business story.

3. Pre-incubation, validating idea and entrepreneurial intentions

Most HEIs have an incubator workspace, offering mentoring and education and sometimes some forms of funding. They include the following.

The University of Zagreb has created a student startup incubator SPOCK managed by FER with 10-months entrepreneurship programme for a limited number of selected student teams (4 teams per year). SPOCK offers student teams co-working space, access to the faculty equipment, mentoring, workshops, networking with companies and investors and some funding (around 2 000 EUR per team).

The University of Split has established a student business incubator run by economics faculty with initial EU funding, about 7 projects per year, 3 months duration

The University of Dubrovnik works closely with the city incubator.

Step Ri, the Rijeka Science and Technology Park is owned by University of Rijeka and acts as pre and full incubator. Founded 10 years ago it was a mechanism for cooperation across faculties. Student teams get legal advice, mentoring and some funding (EUR 5 000). However, it does not have many applications, supposedly because of sufficient other employment opportunities.

Polytechnic VERN' does have a student incubator offering space, mentorship and IP and legal services. Students are interviewed by mentors as condition for acceptance in the incubator. After 6 months in the incubator, teams pass a review by mentors and have

then to incorporate and are provided with access to funding

Polytechnic Velika Gorica does not have an incubator but students are mentored and allowed to do their mandatory internship in their startup

Polytechnic Zagreb (TVZ) has run the MC2 student competition, which has been organized by the Student Association of the Polytechnic Zagreb over the past 5 years. The competition focuses on mobile, web and IOT solutions, interacting with business and education partners.

4. Starting and building a venture ecosystem
- Internal/external

The Split City Technology Park started in 2017, founded and owned by University of Split. It aims for 10 companies per year.

The City of Rijeka has established an incubator.

The City of Dubrovnik has developed the Entrepreneurship incubator thanks to DURA (the Dubrovnik Development Agency).

The City of Osijek, the Osijek-Baranja County and the University of Osijek established TERA Technopolis as a joint venture in 2002.

Another programme that deserves to be mentioned is PAZ, at the University of Split. PAZ is funded by the European Social Fund to encourage change and creation of a sustainable and resilient economy and local community by identification, education, selection and monitoring of potentials young entrepreneurs at the University. The education programme consists of 5 modules (one per semester) covering business, marketing, finance, legal framework, innovation management, business model and business plan development. Upon completion students work as interns on problems in a company/business related to their idea. As last stage of PAZ, PAZ students will join a multidisciplinary pre-incubator developing their business ideas supported by a 60 thousands Croatian Kuna grant provided by the industry and public funding.

One of the challenges in the program is to have sufficient students with ideas who apply to PAZ. That challenge could be met by framing and structuring the programme not only as a platform for starting a company but also as a learning platform for intrapreneurs. Another practice at Split is the collaboration with Ericsson Nikola Tesla, which hosts a summer camp for student challenges (the IP developed is property of Ericsson).

University Spinoffs

The funnel for commercialization of research starts with a competitive knowledge base spawning inventions. While Croatian universities possess pockets of research excellence, the R&I system in Croatia is still in the emerging stage. The number of invention disclosures and patent applications of the HEIs in Croatia is very limited. The university of Zagreb has spun off 3 companies over the last 4 years and the university of Rijeka 3 over 3 years. All visited HEIs expressed the intention to improve commercialization and increase the number of spinoffs although with some scepticism.

In Croatia, technology transfer is fragmented; in particular in non-integrated universities. It lacks proper tools and process and needs a change in mentality with respect to IP commercialization. The technology transfer structure exemplifies the fragmentation issues of the Croatian system. The University of Zagreb has 4 TTOs all on faculty level and a Centre for Research, Development and Technology Transfer, causing challenges in EU funding and fragmentation of the so much needed expertise. The University of Rijeka has a part-time TTO person, the University of Split targets 1 FTE employee for TTO, The University of Dubrovnik has no TTO but Horizon2020 programmes may provide the opportunity to establish a TTO and the J.J. Strossmayer University in Osijek has a TTO jointly with the City and County. The annex of Chapter 5 provides an overview of the TTO structure at the HEIs the review team visited.

The lack of clarity of TTOs objectives and identity impedes the integration and leveraging of entrepreneurship and innovation competences and resources across HEIs. The position taken by many established TTOs - that university entrepreneurship centers and entrepreneurship courses should be concerned only with education and that business issues of academic entrepreneurship are the exclusive territory of TTOs - ignores the interaction between the research, teaching and economic engagement mission of universities and potential synergy between the research and education mission for technology transfer and knowledge exchange.

Research shows that in practice the TTO's role in increasing entrepreneurial activities of academics and support of academic entrepreneurs appears to be limited. TTOs spend most of their time protecting technology and formalizing the contractual relations around this technology. Much less effort is put into the development of a social environment, which stimulates entrepreneurial activities among academics such as entrepreneurship training, entrepreneurship seminars, etc. and little or no effort at all is put into attracting individuals with a high level of entrepreneurial capacity at the universities (Clarysse et al, 2011).

Croatian HEIs have the opportunity to (re)define the TTO function and integrate it with a university entrepreneurship support centre, which would allow to build resources and expertise. The expertise and support needed for research spinoffs is very similar to the needs of start-ups and intrapreneurs. This combined function should have expertise in: evaluation of business value of ideas and inventions; IP strategy and management; legal and contractual expertise, a wide business network; coaching and mentoring of academic and student entrepreneurs; entrepreneurship related education; access to funding and incubators. While an entrepreneurship centers' single task is to provide entrepreneurship education of faculty and students and to support entrepreneurship activities, the TTO has an additional task of safeguarding and transferring technology through other channels than spinoffs. Incentives and capacity of such a combined centre should allow for this additional, specific TTO task.

Education of researchers both faculty (professors) but even more so, graduate students in technology and IP management, project management, research funding and entrepreneurship education exposing them to the opportunity of applying their research is important. Research has shown that graduate students (PhDs and postdocs) are potential founders of spinoffs as an alternative career option (Boh, De Haan, Strom 2016). Some leading research universities such as MIT, Columbia and Cornell in the US have specific commercialization courses for their PhD students. The Jacobs Technion-Cornell Institute (Box 4.6) in New York City runs a unique postdoc programme in which postdocs can apply and commercialize their research through a spinoff.

A critical condition for spinoffs is access to funding to cross the so-called “valley of death”. New ventures need funding to validate discoveries of basic research and to assess whether the discovery can be commercialized. This is in particular a barrier in high-tech fields such as life sciences and renewable energy. With a yet underdeveloped funding infrastructure of crowd, angel and VC funding in Croatia, in particular in the early high-risk phase, government support must offer solutions. In the case of Croatia, EU and World Bank funding is a significant funding source. The Proof of Concept and RAZUM programs with support of BICRO had a positive impact on early stage innovation (World Bank 2015). However, it appears that more recently BICRO programmes have had seen their funding and impact reduced.

These programs and funding should lay the foundations for a sustainable funding mechanism after international funding is terminated. Croatia has significant lower levels of venture capital investments than comparable countries in the region (World Bank 2015). But as the case of small innovative OECD countries such as Israel illustrates (Box 4.7) even with the existence of a vibrant, sustainable, private funding tech ecosystem, the need for early stage government funding remains. This early stage government funding support is in particular needed for new technologies that have a much longer validation time horizon.

Box 4.7. The Israel Innovation Authority

The Israel Innovation Authority provides a variety of practical tools and funding instruments aimed at addressing the dynamic and changing needs of the local and international innovation ecosystems (Innovationisrael.org.il) and to support very early stage ideas and entrepreneurs too risky yet for business investors. The Start-up and the Technological Infrastructure divisions of the Innovation Authority offer tools to support the early development stages of technological initiatives. These tools are:

- The Tnufa incentive program for starting entrepreneurs to fund the proof of concept and business feasibility of their project. A grant of 85% of an approved budget with a maximum of EUR 48 000.
- The Incubators Incentive programme (total 19 incubators), supporting entrepreneurs with innovative technological concepts at the initial stage of R&D in establishing start-up companies and helping them to reach a significant fundable milestone. Budget is limited to EUR 840 000 for 2 years (EUR 1 944 000 for biotech). In addition administrative and business guidance and access to follow-up funding are provided.
- The Early stage incentive programme through a conditional grant of 50% of the approved budget EUR 1 200 000 - for two years and a conditional grant of 85% of approved budget with a maximum of EUR 480 000 - for minority applicants.
- The Young entrepreneurship incentive programme. This programme is intended for organizations that are interested in instilling the basics of entrepreneurship and innovation for students in middle and high school.
- The Angels law. Individual investors (angels) are given the option to deduct the investment amount from their current expenses for tax purposes.
- The Magnetron Incentive programme to transfer breakthrough technology from academia to industry. 2/3 of the research budget is granted by the Innovation Authority, 1/3 by the partner company.
- The Nofar Incentive programme for supporting applied research in bio and nano technology, for ideas that are not mature enough for the Magnetron programme. The Innovation Authority pays 90% of the budget for a maximum NIS 550 000 - and a period of one year. The remainder 10% is provided by the partner company and gives it the first right to negotiate a commercialization agreement.
- The KAMIN incentive programme serves as a bridge between basic and applied research and technologies with commercial applications. The Innovation Authority provides conditional grant of 85-90% of budget up to NIS 400 000.

Box provided by the author of this chapter adapted from Israel Innovation Authority (2019, "The Israel Innovation Authority", www.innovationisrael.org.il/en/contentpage/israel-innovation-authority, accessed in April 2019

USOs and in general tech start-ups can only thrive in a vibrant ecosystem with the following key components: an entrepreneurial research university, a sustainable start-up mechanism comprising entrepreneurs, mentor expertise, professional services and a funding process. An additional critical component is the presence of innovative companies preferably multinationals as part of this eco-system. The exchange of knowledge and spillovers

between spinoffs and start-ups and the absorptive capacity of incumbent companies to identify, assimilate, transform, and apply valuable external knowledge is essential for the growth of new ventures.

Often these new ventures act as outsourced research agents of incumbent companies and are acquired when successful. The cooperation between Erikson Tesla labs in Split which grew in few years from 200 to 500 people and the University of Split illustrates the point. The OECD Investment Policy Review of Croatia, prepared in the framework of the country's adherence to the OECD Declaration on International Investment and Multinational Enterprises, provides additional examples in this regard. The government should aim at targeted foreign direct investment as part of their Smart Specialisation Strategies. In a small innovation intensive country like Israel, for instance, this targeted policy and availability of engineering talent and the knowledge provided by universities and start-ups has resulted in over 300 foreign companies' labs, employing 71 000, a quarter of the country's tech workforce (Dun and Bradstreet 2017) and funding of a large part of the 4.2% GERD of GDP in Israel.

European funding and strategies, including the Smart Specialization Strategy adopted in 2016 can be a good opportunity to promote innovation and entrepreneurship Croatia. A good example of a European funded research project is the EIT KIC Raw Materials project in which the University of Zagreb is a partner. KIC projects integrate higher education, research and business in areas of high societal needs (knowledge triangles). To stimulate Business Creation and Support including Incubator Services for new start-ups a business idea competition including business workshops is part and parcel of the KIC project.

Conclusions and policy recommendations

The recommendations below follow the analysis of the previous sections. They contain areas for improvement for both the national government and individual HEIs. It is nevertheless acknowledged that HEIs differ in their main mission: research university versus polytechnics, in size and age and in governance structure and hence although these recommendations apply to all HEIs, implementation may differ per HEI.

Establish a centre of competence for innovation, entrepreneurship and new ventures and technology transfer on the HEI level reporting to top management.

The development of an entrepreneurship centre at university level presently lacking in most HEIs is recommended. Ideally this centre will incorporate both the functions of a typical University Entrepreneurship and Innovation Centre and of a TTO. This centre will act as the HEI's gateway for technology transfer, new business and venture development and knowledge and education engagement between the HEI and business community, both for polytechnics and research universities. Reasons for this combination of resources and objectives at HEI level are:

- Economies of scale and scope. Most competences and activities needed to prepare and support the different types of HEI entrepreneurship are overlapping and relevant for all university's faculties (e.g. legal regulations, IP issues, access to markets, mentors and funding, courses of training of staff and students, soft skill training, space requirements, relations with local business sector, etc.). The fragmentation of the already minimal resources available prevents implementing of plans and progress in technology transfer and supporting entrepreneurship.

- Avoiding the typical frictions around traditional TTOs by allowing more flexibility and experimenting with IP policies, by training and involvement of staff and students and by offering research application and commercialization expertise to faculty and students in the early stages of research projects and their funding. Traditional tech transfer begins once the research outcomes are complete, which is far too late in the process. Tech transfer officers (called sometimes Innovation Managers) should be involved early when researchers are applying for funds. Doing so would create incentives to link with companies early in the research life cycle. Those same “Innovation Managers” with their experience and network can also educate and consult students whose innovation is not directly related to the university intellectual property. TTO and Entrepreneurships Centers overlap in their competences and objectives but also differ. The single objective of entrepreneurship centers is educating and supporting entrepreneurship at universities while TTOs are required to capture and protect IP developed at research universities and transfer that IP not only through spinoffs but also through licensing. However the synergy, critical mass of resources and cost effectiveness of a joint centre outweighs certainly at the present stage any rational for task and resource separation.
- Providing a platform for the much needed collaboration between faculties and in some cases even between universities on entrepreneurship education, supporting of entrepreneurs and research commercialization. In particular for non-integrated universities such a centre is needed to create a critical mass of resources. Incentives at national level could facilitate the establishment of such a centre.
- Being a transparent gateway for cooperation with the business community.

Staffing of such centre could initially be minimal provided that the center’s personnel has the experience and legitimacy to leverage other resources in the university and beyond. Government should provide initial funding for this new style Entrepreneurship Centre/TTO with as condition that it is a university-wide function covering all faculties.

This centre could coordinate and be a centre of expertise and resources for entrepreneurship education, extracurricular activities and student startups, student innovation projects with industry and will be the centre for expertise for researchers to commercialize their research. The needed skill set for these activities is similar. The actual activities may be allocated to a “TTO” section, a student support section and an education section within that centre dependent on the size of the centre. The case of Inovacentrum at the Czech Technical University is an example of a joint TTO –Entrepreneurship Centre (Box 4.8). An example of a new style TTO being an integral part of the entrepreneurship eco-system of the university is COMOTION (Box 4.9), the TTO function at the University of Washington-Seattle.

Clarify the objectives and expectations of technology transfer and the role of TTOs

The expectation by many universities that Technology Transfer is a certain source of income of universities is misguided. Most universities do not even earn enough from their licensing revenue to cover the costs of their TTO (Valdivia 2013). The Association of Public & Land-Grant Universities in the USA published in November 2017 the report “Technology Transfer Evolution: Driving economic prosperity”. This report calls for TTOs being more aligned with the university’s broader economic engagement mission, linking to

broader economic engagement, education, and research mission beyond patents, licensing and transactions, and becoming an integral professional partner in the academic entrepreneurship eco-system.

IP arrangements should be flexible to best serve technology transfer objectives. The IP policies and the role and capabilities of TTOs are subjects of a worldwide debate because of lack of clarity of purpose of TTOs. Rigid IP policies and overestimation of the value of IP by university and researchers are the cause of identity and legitimacy problems of many TTOs as well as of difficult cooperation with industry. TTOs as agents of technology transfer do not have one but multiple “clients”: the university, the university researchers-inventors and student-inventors/entrepreneurs and are often caught between conflicting expectations and perceptions by these different “clients” (O’Kane et al, 2015) often resulting in an adversary win-lose instead of cooperative win-win relation between the HEI, inventors and industry.

Box 4.8. Beyond Technology Transfer: The case of Inovacentrum in the Czech Republic

Inovacentrum is the TTO of the Czech Technical University (CTU), a 300-year-old university with 8 faculties and over 24 000 students based in Prague. CTU started its first programme to support business and innovation when it established BIC (the Business Innovation Centre) in 1991. In 2007, a discussion was opened at the CTU to engage in third mission activities. As an outcome, Inovacentrum was established in 2010.

The main mission of the centre stands on three pillars:

- educating people and cultivating innovative thinking and co-operation;
- connecting and bridging research with industry;
- supporting the transfer and commercialisation of research results.

Inovacentrum also manages the CTU Incubator by providing support to start-ups within CTU and other Czech universities. For example, Incubator companies receive professional training in business planning, marketing, accounting and other soft skills.

Inovacentrum also provides specialised education to academics and researchers at the university as well as to other technology transfer agents (e.g. seminars, lectures and courses for scientists and internships, and best practice exchange). The scope of themes ranges from IP Rights, through technology foresighting and road-mapping to seminars aimed at improving soft skills necessary for effective sales, networking, promotion, etc. Every year, Inovacentrum is the co-organiser with another renowned partner of a large-scale international conference, concentrating mainly on best practice exchange in areas important for effective innovation and transfer of technologies.

Source: OECD 2013b

Box 4.9. CoMotion, a collaborative innovation hub at the University of Washington, US

CoMotion is the collaborative entrepreneurship and innovation hub of the University of Washington (UW). CoMotion's mission is to expanding the economic and societal impact of the university. By developing and connecting the university to local and global innovation ecosystems, CoMotion aims to deliver the tools and connections that UW researchers and students, need to accelerate the impact of their innovations. CoMotion provides consultant services ahead of invention disclosures and provides innovation training and innovation transfer strategy building in cooperation with appropriate resources at the university such as the business and law school. CoMotion also offers services to undergraduate students who typically own the IP related to their innovation.

Source: <https://comotion.uw.edu>

Provide a separate budget at university level for IP protection as part of the new style TTO budget

The present ad-hoc, case by case approach does not allow for proper IP protection and the building of an IP portfolio through invention disclosures and patent applications. Such a budget will also ensure that within the combined Entrepreneurship Centre/TTO function the role of the TTO as protector of university IP will be safe-guarded. Any financial benefits from IP commercialization may then cover IP protection expenses.

Participate and leverage the Higher Education Smart Specialization programme²⁴ and develop the capacities (generative, absorptive, collaborative, leadership) of each HEI in the context of smart specialization

Traditional HEIs TTO's aim to commercialize solutions (inventions) in pursuit of a problem. However, TTOs should be involved earlier in the university activities, for instance when researchers apply for funds as it is envisioned in the proposed combined Innovation-Entrepreneurship-TTO Centre. Doing so would create incentives to link with companies early in the research life-cycle. Smart Specialisation Strategies are place based, regionally oriented. Every university can work on the establishment of a strong partnership with the private sector if it takes a proactive interest in the private sector in its region.

Strengthen entrepreneurship education by stimulating across faculty courses and/or general courses with specific faculty related modules targeting the development of entrepreneurial mind-sets

Stimulating interdisciplinary project courses for graduate students needs to be encouraged. These should avoid the narrow-minded approach that entrepreneurship courses are all about starting a company, since most students and faculty members will not end-up starting companies. Emphasizing an entrepreneurial mindset in applying university studies and building new products and services is of great importance. Best would be that each HEI develops a HEI wide integrated program in educating innovation and an entrepreneurial

²⁴ For more information see JRC S3 Policy Brief Series No.23/2017

mindset jointly with the local community and business sector. Elements could be courses and workshops in creativity, product/service development, change management; internships; problem based project courses in industry; innovation competitions; championing intrapreneurs. Most of these elements are already operational in Croatia's HEIs. Integration of these elements in programmes and across all faculties/disciplines would be an additional step and could be one of the tasks of the Entrepreneurship Centre. Also it would be important to provide national incentives in terms of budget and teaching credits and recognition for the students who completed such an "innovator/intrapreneur minor". The MIT Innovation and Entrepreneurship Minor is a good example of such a program and related courses²⁵.

²⁵ More information at: <https://innovation.mit.edu/education-practice/eiminor/>

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Chapter 5. Knowledge exchange and collaboration ²⁶

This chapter assess knowledge exchange activities that Higher Education Institutions in Croatia have developed with partner universities, the business sector and non-profit organizations at a national and international level. In particular the chapter highlights some of the challenges that Croatia faces at a systemic level to promote knowledge exchange activities between Higher Education Institutions and other institutions, such as the level of national funding allocated to knowledge exchange activities, the efficiency of the national research and innovation system. It also goes through many knowledge exchange initiatives that HEIs have implemented with local incubators and companies and with industries and partner HEIs at an international level. The chapter concludes with some policy guidelines addressed to the national government and to HEIs to continue enhancing knowledge exchange activities.

²⁶ In the context of this report HEI refers to Croatian Universities, Polytechnics and Schools for professional higher education, but not to individual Faculties within a University.

HEIs have become increasingly involved in knowledge exchange over the last decades in OECD and European countries

Over the past 30 years across many OECD and European countries, HEIs have developed a variety of forms of knowledge exchange. These mechanisms promote interactions between the higher education sector and knowledge users outside the academia. While HEIs traditionally perform two missions – education and research, increasingly they put greater emphasis on the so-called ‘third mission’—that is their contribution to the business sector, the economy, local and regional development, and the society more generally. Building and sustaining relationships with key partners, collaborators and a broad range of stakeholders is a key factor for HEIs to successfully engage in knowledge exchange activities, and contribute to promoting innovation and entrepreneurship.

Many OECD countries and emerging economies have been developing policy initiatives to promote knowledge exchange between HEIs and key actors of national and local innovation systems. These initiatives may take the form of policy instruments specifically promoting knowledge exchange or governance mechanisms to connect HEIs with government and wider societal actors and the business sector (OECD 2017). Many mechanisms to promote such activities at national and sub-national policy level, as well within the university exist. They include, for instance, the framework for intellectual property rights (IPRs), the introduction of national funding stream designated to knowledge exchange activities, innovation vouchers to encourage businesses to work with HEIs, and the reward and promotion criteria for academics to engage with broader knowledge users. The scope and the activities of knowledge exchange are thus very broad.

There is no one-size fit all model for knowledge exchange policy and initiatives

Knowledge exchange covers a very wide range of activities and it is not only associated to the commercialization of research outcomes in science and technology fields. However, both policy and academic discussions around knowledge exchange have tended to over-emphasize the creation of academic spin-offs and start-ups and/or the licensing of IPs, based on the science and technology-related research outputs of the university. Beyond commercialization activities and other forms of academic engagement, HEIs foster innovation capacity by enforcing social creativity and cultural development and providing the basis for the expansion of the knowledge economy by social and cultural local engagement (European Commission, 2017a).

Knowledge exchange takes different forms – *academic engagement* such as collaborative research, contract research, consultancy, and *academic entrepreneurship* including the income generation derived from intellectual properties (IPs), the formation of spin-off firms and start-ups (Rothaermel et al., 2007; Perkmann et al., 2013). Other types of knowledge exchange include *public engagement, community engagement, cultural and social forms of exchanges*. These different channels involve individual academics and groups of academics, as well as the departments, faculties, and the university as a whole.

When discussing knowledge exchange activities, it is important to remember that students are key actors. During their studies, students interact with future employers through student placements and work-based learning either as extra-curricular activities or as part of their degree programmes (European Commission, 2017a). When students graduate and enter the labour market, they are not just ‘human capital’ – they bring the ‘knowledge capital’

gained through their education, that facilitates innovations, whether in the business, public or societal sectors.

Universities also enrich the overall human capital by other forms of knowledge exchange, such as continuing professional development (CPDs) (e.g. post-qualification education), and lifelong learning provisions throughout different stages. Knowledge exchange involves different partners (e.g. large firms, small and medium enterprises (SMEs)), public organizations and communities and non-governmental organizations (NGOs).

Universities themselves also vary in terms of their missions, size, resources, and the range of disciplinary areas. Furthermore, informal linkages such as individual knowledge networks are often a key channel for knowledge exchange activities - serving as a prerequisite for later more formal cooperation between organisations. There is an organic relationship between teaching, research and knowledge exchange activities, and such relationships vary at individual HEIs, and within each disciplinary area and across individual academics.

Finally it is important to note that not all knowledge exchange activities are quantifiable. Evaluating the impact of knowledge exchange activities would require consideration of different dimensions and data-sets.

Knowledge exchange in Croatia, a historical perspective

Beyond specific innovation and entrepreneurship activities within HEIs, the nature of innovation and entrepreneurship in Croatia is, to a large extent, the consequence of the economic trends over the last two decades. When part of the former Yugoslavia, Croatia had a strong research capacity within the large enterprise sector. Following the break-up of Yugoslavia many large companies collapsed and collaborative relationships between the academia and industry were lost. Some part of the country still suffers from this legacy.

Nevertheless, Croatia succeeded in preserving science capacity in public research institutes and universities, and managed to maintain a greater research capability than most other transition states of Eastern Europe (Bartlett and Cuckovic, 2006). Croatia's economic and social development achievements between 1996 and 2008 showed an economic growth of approximately 4% per annum, and Croatia was closing in on the income gap with the European Union (Marijanovic, et al. 2013). However, between 2009 and 2015, Croatia was hit by the global economic recession, with growing account deficits, small gains in productivity and scarce innovation.

Since joining the European Union in July 2013 in the middle of the economic recession, being part of the EU single market and having been able to access the EU grant funds helped the economic recovery that started in 2015. For HEIs, the participation into EU programmes has meant new opportunities for international exchanges and has broadened knowledge exchange activities with a wide range of knowledge users outside the academia. However, in the absence of adequate institutional reform and preparation, the sudden increase in resources devoted to innovation activities (primarily from EU Structural Funds, but also from other sources) was not accompanied by a proportionate increase in outputs or meaningful impacts on the Croatian economy (OECD 2013).

Currently, Croatia faces a number of challenges such as high debt levels in the state and private sectors, a low employment rate, unfavourable demographic trends, and a cumbersome investment climate (World Bank, 2018). There are a number of challenges faced by Croatian HEIs, which need to be tackled as part of these wider societal and

economic issues; and the development of strategic knowledge exchange activities may be instrumental to solve some of these socio-economic challenges.

Knowledge exchange varies according to the characteristics of the individual HEI

HEIs in Croatia are diverse in terms of their size, governance structure, resources, and missions (as described in Chapters 1 and 2). An old and large university like the University of Zagreb, newer and middle-sized ones such as the Universities of Split, Rijeka and Osijek, smaller ones such as the University of Dubrovnik, and polytechnics differ significantly in their missions, resources and the nature of their knowledge exchange activities. In addition, there are differences between public and private HEIs. The nature of knowledge exchange activities and the ways in which these are organized and managed are significantly different across these diverse types of HEIs. More specifically, this chapter aims to answer the following questions:

- *What are the expected roles and barriers for the higher education sector in order to enhance knowledge exchange and innovation?*
- *What is the role of government intervention in the support of innovation and knowledge exchange in Croatia? How to balance teaching, research and knowledge exchange in Croatian HEIs?*

The rest of this chapter is structured as follows. Following this introduction, the second section provides a systemic overview and identifies key opportunities and challenges at the national policy level for promoting knowledge exchange activities in Croatian HEIs. The third and fourth sections address different dimensions of knowledge exchange activities at the organizational level, identifying good practices as well as constraints. The final section concludes by providing policy recommendations.

A systemic view to knowledge exchange in Croatia's HEI, challenges and opportunities at the national and international policy level

From a systemic perspective, at the national policy level, including in the field of higher education, science, research and innovation policies, several key obstacles and challenges vis-à-vis the promotion of knowledge exchange activities between Croatian HEIs and their partners exist. In terms of challenges faced by the Croatian national research and innovation system, issues are present with respect to both the supply and demand side of knowledge exchange activities.

Resource constraints of the Croatian HE system

The level of public and private expenditure in the higher education sector as a proportion of GDP is a good indicator of the priority given to higher education, not only by governments but also by society as a whole. According to the Croatian country report published by the European Commission (Šćukanec 2013), before 2013 the level of investment into higher education as percentage of GDP has been declining in Croatia in terms of both public investment and private investment. As in many EU countries, the proportion of public funds has been decreasing – on average, the proportion declined by 10% from 1995 to 2008 (File et al. 2013). Since then, however, the share of investments in HE has increased (Chapter 1) but it remains below advanced EU and OECD countries.

Low quality and efficiency of the national research and innovation system

The low levels of R&D performed by Croatian enterprises,²⁷ in particular, medium sized firms, is one of the key issues for the Croatian innovation system (OECD 2013; World Bank 2015). To overcome this weakness, it is necessary to raise the share of innovative firms and their capabilities to increase the demand for R&D activities in the business sector (World Bank 2015). Over the last decade, specialized agencies and intermediaries have been created to implement policies to strengthen science, innovation, entrepreneurship and SME support (e.g. CSF, HAMAG-BICRO, HIT),²⁸ with varying degrees of continuity, operational independence and capabilities. In terms of innovation support, in particular, the function and programmes of the former innovation agency BICRO, after several successful rounds of programme delivery and implementation, have progressively been reduced in scope and could be strengthened in the future.

Inadequate higher education reforms

The links between innovation policies and higher education reforms are weak and fragmented. For example, the creation of auxiliary organizations (e.g. university incubators, science parks) has not been accompanied by reform of the HEIs themselves (OECD, 2013). In addition, the scope of innovation and entrepreneurship policy has focused mostly on R&D in science, technology, engineering and mathematics (STEM), medicine and manufacturing areas. Croatia should base its policy on a broad concept of innovation, to include – in addition to R&D – marketing, organizational, and service innovation (e.g. tourism sector). This needs to be linked to the wider range of knowledge exchange activities and capabilities of HEIs including social sciences and humanities, and interdisciplinary collaboration across academics and users.

Weak multi-level “policy governance”

Strengthening and improving the “policy governance” is necessary to strengthen the impact of research and innovation European programmes such as Structural and Investment Funds (World Bank 2015). There was progress in improving governance by merging existing research and innovation institutions, but in some cases, the functional specialisation and range of actions of these agencies may have remained limited (OECD 2013). As already mentioned, in the absence of adequate institutional reform and preparation of the HEIs and public research organisations, the increase in resources from the EU devoted to innovation activities has not led to a proportionate increase in outputs or meaningful impacts on the Croatian economy. The insufficient use of Horizon2020 programmes and other international initiatives is often recognized as a recurrent challenge, both for the universities and for the national government. In terms of regional development, limited

²⁷ A small number of corporate research institutes in industry act as private scientific institutes: Ericsson Nikola Tesla (telecommunications technology), INA (oil and gas), Končar electro-technical institute (engineering) and the Galapagos research institute. The most significant industrial research spender on R&D is Ericsson Nikola Tesla which specializes in information and telecommunication technologies (Šćukanec 2013).

²⁸ Several key institutions have been established in order to increase competitiveness and efficiency of the Croatian innovation system including Business Innovation Center (BICRO), The Croatian Institute of Technology (HIT) (see Marijanovic et al. 2013). Established in 1997, BICRO’s mission was to link innovative business firms with R&D at universities and financial institutions. BICRO has been responsible for implementing the government’s programme for the creation and development of knowledge-based SMEs, drawing also on regional and local funding (Bartlett and Cuckovic 2006). BICRO was then merged to become HAMAG-BICRO and its focus has changed over time.

capacities and fragmentations of units at the local level as well as the concentration of population and resources in Zagreb pose challenges for the development of strong local and regional innovation ecosystems.²⁹

Coordination between national and international R&I systems

The coordination between national and international science and research policy domains is of strategic importance for Croatia. The number of researchers in Croatia has been decreasing over time, notably due to emigration and the lack of new R&D jobs, especially for young generations of researchers.³⁰

At the same time, recent developments of the Croatian innovation system present new opportunities for HEIs and their knowledge exchange activities, in particular as the higher education sector is increasingly playing an important role in the Croatian R&D system. For example, in order to tackle “brain drain” and to favour “brain circulation”, the Croatian Science Foundation (CSF) runs the programme *Unity Through Knowledge Fund* aiming to encourage scientists and experts of Croatian origin living abroad to return to Croatia and foster cooperation with Croatian scientists.

Diversified HE revenue streams

Over the last years across the higher education sector, income from sources other than the state budget grew in most of the HEIs, including universities and universities of applied sciences (UASs), public and private HEIs (Doolan et al. 2012; Šćukanec 2013). HEIs are deemed to be “entrepreneurial” when they maximize their potential, diversify their funding sources and reduce dependency on state/public funding (Clark 1998; OECD/European Commission 2012³¹). The growth of non-public funding may imply the increasingly “entrepreneurial” nature of HEIs in the Croatian HE system with growing emphasis on collaboration and dissemination of research at regional, national and international levels. These are discussed more in detail in the following sections.

Smart specialisation strategies and multi-level policy governance mechanisms

Several national-level strategies to support R&I have recently been developed to complement the 2014 strategies for education, science and technology and for fostering innovation (European Commission, 2017b). In particular, the *Smart Specialisation Strategy* (S3) adopted in March 2016 is an important framework for implementing ESIF funding effectively and ensuring that R&I activities are fostered in five key thematic priorities (health and quality of life; energy and sustainable environment; transport and mobility; security; food and bio-economy). For the S3, strategic governance and coordination at the

²⁹ The Law on Regional Development was implemented in 2009 in line with the EU’s Cohesion policy principles. However the slow implementation processes indicate that regional policy institutions are still facing significant obstacles related to their limited administrative capacity and the influence of sectoral line ministries (Malekovic et al. 2011).

³⁰ Over the 2000-2010 period, the total number of FTE researchers in Croatia decreased by almost one quarter, from 8,572 to 6,847 between 2002 and 2011. According to Eurostat and available data, Croatia had 8,572 FTE researchers in 2002. In 2010, this number decreased to 7,104 FTE researchers, then to 6,847 in 2011 (World Bank 2013). Overall it has remain stable and well below EU averages between 2006 and 2016 (Chapter 1).

³¹ See the HEInnovate guideline document (OECD/European Commission 2012).

national level across different ministerial mandates remains critical. In this light, the recent development of the National Innovation Council is very relevant for coordinating implementation.³² Croatian HEIs could play strategic leadership roles in bringing a variety of stakeholders together.

Policy issues regarding knowledge exchange in the Croatian higher education system

As discussed above, in a challenging funding landscape with severe resource constraints, diversification of income streams is paramount for HEIs, and collaboration with a wide range of knowledge users through knowledge exchange activities is key to unlock new opportunities at local, regional, national and international levels. Working with industry, government and other partners in the society through research and teaching is important not only as a funding source, but also as a route to identify emerging needs of research users, and employability opportunities for students.

At the national higher education policy level, knowledge exchange activities are recognized as part of the missions of HEIs in Croatia. Under the current higher education and science policy framework, some forms of knowledge exchange activities are recognized as part of the criteria of eligibility for resources under performance-based funding mechanisms. However, this is a very small part of HEI's resources, with very limited influence on the institutional strategies.³³

There are several structural challenges and constraints vis-à-vis the development of knowledge exchange activities in Croatia. These include restrictions and lack of flexibility on employment of academics. It is difficult to recruit staff with non-academic background, in particular coming from the business sector. Another key constraint for knowledge exchange is the underdeveloped national regulations, guidelines and legal framework for intellectual property rights. There is also a challenge in terms of the development of systematic strategies and the collection of indicators around knowledge exchange activities due to discontinued funding.

Academic incentives, rewards and workload models

In terms of the institutional practice, in most cases, knowledge exchange activities are neither recognized as part of the academic workload nor rewarded as part of the promotion criteria. If HEIs are truly committed to make a cultural change at the institutional level and changes in individual academics' behaviour, they should consider developing a coherent system of incentives to promote and reward knowledge exchange activities.

³² The Smart Specialisation Strategy was adopted by Croatian Government on 30 March 2016. The purpose of this Strategy is to create a necessary stimulus for Croatian economy and increase its competitiveness by concentrating knowledge resources and linking them to a limited number of priorities. Specific measures will be implemented to raise competitiveness of thematic and sub-thematic priority areas through promoting RDI activities and investments, both in research organizations (including HEIs) and business sector.

³³ A significant change occurred in the academic year 2012/2013 through the introduction of a pilot scheme for three-year funding agreements between the state and public HEIs. These agreements introduced performance indicators, allowing institutions to receive additional funding if they meet specific policy objectives. Other indicators are related, for example, to the social dimension of HE through fostering access of under-represented groups and non-traditional students, or related to a reduction of drop-out rates. However, performance-based funding is still very limited and estimated at around 1% of overall ministerial funding for HE institutions (Brajkovic 2016).

In particular, there should be incentives for knowledge exchange activities both at the national higher education policy level and individual institutional level. These may not be just financial incentives such as those related to IPRs. Knowledge exchange activities need to be part of promotion criteria if these are considered to be a key component of the HE missions and activities.

Currently, the national regulation regarding the academic workload at Croatian HEIs (i.e. teaching and research 50/50%) not only dis-incentivizes academic staff in undertaking entrepreneurial and knowledge exchange activities; it also creates inflexibility in terms of managing resources for these activities at the institutional level. The relationships between teaching, research and knowledge exchange are complex and may require different timeframes and approaches (see also the discussion in Chapter 4). As a consequence, academic workloads would need to be implemented in a flexible manner to reflect the complex nature of academic work, and relationships between research, teaching and knowledge exchange.

Regulatory frameworks for knowledge exchange activities

In Croatia, the national legal frameworks for IPRs are underdeveloped. These include guidance regarding incentives for researchers to participate in technology transfer and other knowledge exchange activities. For example, the possibilities for researchers to participate in licensing revenues and equity participation in new spin-off firms are all relatively new developments in Croatia (World Bank 2013). Several universities have developed their own IPR guidelines (e.g. Universities of Zagreb, Rijeka, and Split). However, a standardized approach to IPRs should be developed to clarify and harmonise rules.

Improving data management and strategic planning

In Croatia, a major obstacle to policy development in general is the lack of data, which means there is no systematic approach towards “strategic evidence-based decision making” (Šćukanec 2013). In the area of knowledge exchange activities, a better data management and strategic planning and implementation is needed both at the national and institutional levels.

Some development are underway for the design and delivery of individual study programme at HEIs. For example, some efforts in the direction of the recognition of knowledge exchange activities and systematic data collection has been made through the accreditation system developed under the Agency for Science and Higher Education (ASHE) in Croatia as described below (Box 5.1).

Box 5.15. Knowledge exchange as part of the Quality Accreditation of HEIs

The first 5 year cycle of accreditation under the Agency for Science and Higher Education (ASHE) (2012-17) incentivised Croatian HEIs to start developing their institutional strategies further. Under the current second cycle of accreditation, the importance of knowledge exchange activities at the institutional level has been emphasised. For instance, relevant standards include³⁴:

- The HEI understands and encourages the development of its social role;
- The general objectives of all study programmes are in line with the mission and strategic goals of the HEI and the needs of the society;
- Lifelong learning programmes delivered by the HEI are aligned with the strategic goals and the missions of the HEI, and social needs;
- The HEI provides evidence of the social relevance of its scientific/artistic/professional research and transfer of knowledge;
- Scientific/artistic/professional achievements of the HEI are recognized in the regional, national and international context.

Evidence and indicators of both research-related and teaching-related activities is going to be collected at the institutional level over the next 5-year period of the accreditation cycle. These include: ‘commercially responsible technology transfer, aimed at contributing to the local and regional development’; ‘public lectures/round tables, publishing activities and other types of public activities of HEI’s staff in their respective professional fields, conducting educational programmes for different social groups, participation in events contributing to the popularization of science, participation in research with different social groups incorporating HEI’s community engagement activities in the teaching process’.

An ongoing foresight project that collects data on research in a systematic way, together with the development of the information system on Croatian research activities (*CroRIS*), is envisioned as a unique, integrated, and interoperable information system on Croatian research activity within the Ministry of Science and Education. It will enable the input, storage, management, access, and dissemination of relevant information on Croatian research, its basic components (e.g. academic and research institutions, research equipment and personnel), and type of activity (e.g. mobility of researchers, research groups, research activity and productivity, participation in research events). However, currently, there is no systematic data collection mechanism at the national level on HEIs’ knowledge exchange activities.

There are clear and explicit links between knowledge exchange activities, the enhancement of teaching and learning, and students’ employability. Engagement with employers and communities is central to make higher education programmes relevant and valid to the needs of the businesses and society. In addition, given the importance of students and graduates as knowledge exchange actors, data collection on the graduate destinations is

³⁴ “Standards for the Evaluation of Quality of Universities and University Constituents in the procedure of Re-Accreditation of Higher Education Institutions” (Agency for Science and Higher Education/AZVO 2018)

another area where Croatian HEIs can develop data collection and indicators. While individual HEIs are making efforts, a more systematic national and international approach is needed.

The Ministry of Science and Education may consider building on the existing national initiatives (e.g. ASHE data; CroRIS) and international projects (e.g. EUROGRADUATE pilot study) to collect information on a range of knowledge exchange activities with different partners, and better understand networks through researchers and graduates.

National funding allocation for strategic knowledge exchange activities

Currently, there is no national earmarked funding available for HEIs in Croatia in order to develop institutional strategies, infrastructure and initiatives for knowledge exchange activities. There have been a number of initiatives and programmes for a short duration funded by European programmes and other international sources, but these initiatives tend to be discontinued after the initial funding comes to an end. In this light, the balance between funding from the Croatian national government and the competitive grants from European and international bodies (e.g. World Bank) needs to be allocated to ensure continuity and sustainability of these activities. The government may need to consider creating longer term funding dedicated to knowledge exchange, available at the institutional level.

There are different approaches to fund knowledge exchange activities. In general, achieving a better strategic balance between the project-based competitive bidding and formula-based knowledge exchange funding allocation is needed (Kitagawa and Lightowler, 2013). Project-based funding may meet the needs of the institution, and projects may be funded for consortium of HEIs, but they may create ‘long-term instability’ and prevent the development of the long-term institutional strategies for knowledge exchange and third mission activities. Formula-based institutional funding based on performance indicators facilitates funding stability and can be linked to institutional strategies. However, there are challenges in terms of the choice of the appropriate indicators to measure and collect data on the knowledge exchange activities (Box 5.2).

Box 5.2. Indicators to attempt measuring knowledge exchange: examples from OECD countries

There have been attempts across OECD countries to develop indicators to measure the impact of knowledge exchange (sometimes called ‘third mission’, or ‘valorisation’) activities. Some of these activities are quantifiable and others are not. It is generally acknowledged that there is no ready-made one-size fit all set of indicators that matches the broad definition of knowledge exchange. It is also noted that the broader societal and economic use of the knowledge generated in the university needs to be accounted for as part of the complex ecosystems at the national and regional levels. As some of the examples show below, the form of measurement tools and choice of indicators depend on the specific purpose of the measurement and the context of the knowledge exchange activities.

The number of patents and revenue generated from licensing have been widely used as indicators of technology transfer. However, there is a recognition that these indicators capture only limited dimensions and could be misleading. Many stakeholders including the research funders, academic researchers, technology transfer offices (TTOs) and industry partners have sought to come up with a comprehensive set of indicators. For example, the **Association of University Technology Manager (AUTM) in the US** has proposed a broad set of metrics for universities and research institutions to choose from in order to describe and assess the ability to make an impact on the community and economy.³⁵

There are other sets of indicators focusing on student-centred knowledge exchange activities. For example, in the **US**, the Association of Public and Land Grant Universities’ Commission on Innovation, Competitiveness, and Economic Prosperity (CICEP) proposed metrics for regional and national workforce, measuring university student employment from research, student participation in entrepreneurship and alumni impact. The framework consists of a set of questions asking how universities are aligning their education and entrepreneurial programming to support workforce development covering areas such as ‘student employment on funded projects’, ‘student economic engagement’ including number of internships, student entrepreneurship related activities, and the information of alumni in workforce.³⁶

In **the Netherlands**, the term valorisation is used to refer to knowledge exchange activities. In 2010, a comprehensive four-dimensional framework was proposed to measure ‘valorisation performance’, combining quantitative and qualitative indicators. The framework and the indicators can be applicable in a wide variety of settings, including research universities and the University of Applied Sciences (UAS), on several levels and for a variety of evaluation goals. The new approach emphasizes a process-oriented measurement moving away from focusing only on quantitative outcome-based indicators (OECD 2014, 2018). In 2012, when all Dutch HEIs were preparing individual performance agreements with the Ministry of Education, Culture and Science for the first time, the Review Committee invited the HEIs to make use of indicators to illustrate their ambitions with respect to valorisation. Some HEIs responded to this request and agreed to include a number of indicators in their performance agreement as well as in the (mandatory) annual reports they publish each year to report on their overall activity. However, so far, a commonly defined set of indicators used by every HEI is not in place, which makes it difficult to compare results and monitor progress nationally (Jongbloed 2018).

In the **UK**, systematic data on knowledge exchange activities at the university-level has been collected since 1999/2000 under the Higher Education Business and Community

Interaction (HE-BCI) survey, which all HEIs are requested to return data annually. In England, since the late 1990s, there has been a series of national funding dedicated to the strategic development of knowledge exchange activities. Since 2001, the Higher Education Innovation Fund (HEIF) has been awarded to HEIs in England based on their knowledge exchange performances. The funding allocation is based on a variety of knowledge exchange outcomes including the data captured in the HE-BCI survey. The HE-BCI survey includes data on income generated through a broad range of knowledge exchange activities including research collaboration, intellectual property, spin-offs and graduate start-ups, continuing professional development (CPDs), facilities and equipment related knowledge exchange activities, and social, community and cultural engagement activities. Submission of the institutional knowledge exchange strategies is also a requirement of HEIF allocation. It is reported that over the last decade, all knowledge exchange indicators have grown substantially across the HEIs in the sector (Coates-Ulrichsen, 2014). At the same time, the limitation of the use of the common metrics to a diverse range of HEIs including large research universities and small specialised colleges is recognised (Rosli and Rossi, 2015). In 2017, the Government asked the Higher Education Funding Council for England (HEFCE now Research England), to lead on developing the ‘Knowledge Exchange Framework’ (KEF) as part of its broader knowledge exchange policy and funding framework. Currently, KEF metrics and good practices are being developed.³⁷

In **Australia**, as part of the government’s National Innovation and Science Agenda (NISA) (2015), the ‘Engagement and Impact Assessment’ (EI) was piloted in 2017. It aimed to measure HEIs’ research interactions with industry, government, non-governmental organisations, communities and community organisations as well as research contributions to the economy, society and environment. A key principle guiding the development of the EI methodology was that 1) any assessment must be rigorous and, at the same time 2) such assessment should minimise the administrative burden on the university sector. The EI is expected to help drive collaboration between universities and end-users and to help universities focus on research with more direct social, economic and environmental benefits, in addition to conducting fundamental research. The EI has been rolled out in 2018 across all research disciplines, by using a small set of key indicators alongside narrative statements, with all ratings made by panels of experts.³⁸

In many OECD countries finding the “right” set of indicators to measure knowledge exchange activities is an open and sometimes contested issue, given the broad range of activities that go under this label (Molas-Gallart and Castro-Martinez, 2007). It is therefore important to acknowledge diversity and complexity in any attempt to define metrics.

Knowledge exchange initiatives in HEIs in Croatia

The diverse nature of the HEIs in Croatia influences the structure and organizations of knowledge exchange activities at each of the HEIs. These diversities and differentiation

³⁵ <https://www.autm.net/autm-info/about-tech-transfer/about-technology-transfer/new-metrics/> [07/09/18]

³⁶ http://www.aplu.org/projects-and-initiatives/economic-development-and-community-engagement/economic-engagement-framework/related-resources/cicep-new-metrics-field-guide_201405.pdf [07/09/18]

³⁷ <https://re.ukri.org/knowledge-exchange/knowledge-exchange-framework/> [07/08/18]

³⁸ ARC (2017), *Engagement and Impact Assessment Pilot 2017 Report* <https://www.arc.gov.au/engagement-and-impact-assessment/ei-pilot-overview> [08/09/18]

were recognized during the OECD study visits (Chapters 1 and 2). The following sections present some of the most relevant examples.

Building the organisational infrastructure for knowledge exchange

Different types of HEIs in Croatia have been building infrastructure mechanisms supporting knowledge exchange over the last decades (Table 5.1 and 5.2 in Annex). However, the support for knowledge exchange activities at the organizational level seems to be limited due to a variety of structural and historical reasons.

Streams of funding from the international bodies such as the European Union and World Bank have helped Croatian HEIs develop some organizational mechanisms for knowledge exchange activities. These include: the *proof of concept* programme by the World Bank administered by HAMAG-BICRO; the Enterprise Europe Network programme to establish and support Technology Transfer Offices (TTOs); Erasmus + programmes to develop and support student international mobility and internship opportunities; and the European Social Fund to build collaboration with NGOs and local communities. However, when these external funding sources come to an end, even at the level of individual HEIs, many of the initiatives suffer from the issue of sustainability, and tend to lose key staff. Consequently, knowledge exchange activities become fragmented and they are often not part of the long term institutional strategic planning.

One particular organizational issue is found at the ‘non-integrated’ and ‘semi-integrated’ universities characterised by large number of academic staff, students and Faculties with strong autonomy (e.g. at Universities in Zagreb, Split, Rijeka and Osijek).³⁹ While knowledge exchange resources available at the university central level is constrained, individual universities have developed different organizational structures including diversified models of organising knowledge exchange activities.

Technology Transfer Offices (TTOs) are common organizational forms that research oriented HEIs in Croatia have developed over the last decades (Chapter 4 for different international models of TTOs). Different universities have different sources of funding, organizational models for their TTOs and related research and knowledge exchange activities (see Table 5.1 in Annex for examples from HEIs visited). The decentralized structures may be more effective for certain types of knowledge exchange activities, but there are issues of coordination and efficiency of resource allocation at a university as a whole. Certain level of coordination across different Faculties and Departments needs to be ensured by the university management.

Strategic resource acquisition, planning and developing of knowledge exchange activities need to be carried out at the university central level and, at large and non-integrated HEIs, in coordination with the Faculty level. There must be national level mechanisms to help develop such structure.

At smaller and newer HEIs including polytechnics, different challenges are observed. Some of these HEIs are developing their research and knowledge exchange capacities, for instance, through European programmes such as Horizon 2020, but the supporting mechanisms are limited. Smaller and newer HEIs, including the University of Dubrovnik,

³⁹ At traditional, non-integrated universities, the effective implementation of lump sum funding from the state has proven to be rather problematic. Although the agreed public funds are transferred to the universities as a lump sum, the separate legal status of the faculties prevents universities from centrally managing these funds (Brajkovic 2016).

and polytechnics, do not have TTOs but instead have established different industry interface mechanisms (see Table 5.2 in Annex for examples from the HEIs visited).

They have developed different types of organizational structures and strategies related to knowledge exchange activities, and different types of organizational knowledge exchange infrastructure is required. These HEIs typically focus on student centred knowledge exchange activities including internships, employer engagement in programmes and teaching activities, drawing on individual contacts and networks with local businesses and communities. As the activities grow rapidly, there seems to be challenges in terms of sustaining these activities. As a consequence, more strategic prioritization and support may be required at the university level.

At newer HEIs, especially at polytechnics, there are a number of bottom-up knowledge exchange initiatives connecting students and employers. In order to make these activities sustainable, the combination of top-down initiatives and bottom-up networks and interactions is needed.

In Croatia, professional studies are offered in polytechnics, schools of professional higher education, and also, in universities. This allows universities to carry out professional studies, indicating that binary system has not been fully implemented (Brajkovic 2016). Differences between private and public HEI's need to be recognized in terms of their sources of funding and governance procedures, which significantly affect planning, implementation and effectiveness of the knowledge exchange strategies and activities. To illustrate the organizational structures of knowledge exchange activities at different types of Croatian HEIs, some of the characteristics of these HEIs and their knowledge exchange organizational infrastructures are illustrated in Tables 5.1 and 5.2 in Annex.

Knowledge exchange and local and regional development

HEIs are integral part of the region where they are located and cooperate with surrounding actors, such as cluster organisations, science parks or incubators. In addition, a key function of HEIs is the provision of highly qualified graduates for the regional labour market which are an important factors for the attraction of business investments in the region. HEIs are decisive factors that shape the societal, demographic and cultural structures of a city or a region. This includes the attraction of young skilled people and the resulting positive spillovers from regional infrastructures such as education institutions or the supply of cultural activities (OECD 2017).

Over the years, Croatian HEIs have developed close working relationships with actors in their surrounding regions in a variety of ways. Some examples of local engagement include:

- The *University of Split* is strongly embedded in the local innovation ecosystem. The university led the White Paper for the City of Split to develop the IT Community. Nikola Ericsson has a R&D unit within the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture (FESB), and they co-develop curricula.
- The *University of Dubrovnik* has developed a strong link with the City development agency – DURA and the city incubator (see Chapter 4). In addition to the strong link to the tourism industry, the university has developed the Department of Aquaculture aiming to provide education and R&D activities in the field of aquaculture and coastal zone management (Box 5.3), closely working with local SMEs.

Box 5.3. Knowledge exchange in rural areas, the example of the University of Dubrovnik

The Business and Innovation Centre for Mariculture MARIBIC was originally established in June 2008. The Centre has been recently, renamed as “laboratory of aquaculture department” after a restructuring due to financial issues. The laboratory aims to develop: practical education for students, R&D, administrative, legislative and commercial support for regional aquaculture industry, scientific research, contract research, business incubation activities, science promoting activities.

The Centre for Mediterranean plants was established in 2011 by the University of Dubrovnik and recently relocated to the nearby municipality of Zupa Dubrovacka. The mission of the Centre is to monitor and improve the agriculture of southern Dalmatia (olives, figs, carobs, oranges, lemons and aromatic and medicinal herbs). The scope of its work is related to agronomic science with emphasis on fruit growing in the Mediterranean, the production of planting material and the provision of chemical analysis of wine, olive oil and soil. The laboratory of the Centre is the only licensed institution in Dubrovnik Neretva County that can make analyses on olive oil and wine before they are placed on market. Currently the Centre is conducting both scientific and professional projects. The plan of the Centre is to start a professional undergraduate program at the university and it needs to strengthen its organisational capacity in terms of personnel and equipment.

- The *University J.J. Strossmayer in Osijek* is located in the eastern region of Croatia, traditionally an agricultural region, which was heavily affected by the war in the 1990s, and, as a consequence, the industrial links in the region were largely destroyed. Thus the socio-economic and industrial conditions of the region are very different from Zagreb or the cities along the coast. The university has played a catalyst role to attract industry to the region. For instance, the ongoing research and knowledge exchange activities at the Faculty of Electrical Engineering, Computer Science and Information Technology (FERIT) have not only attracted automotive industry to the region, but also Nikola Ericsson Tesla opened an R&D unit in Osijek in 2018 (Box 5.4). The development of knowledge exchange activities seem to go hand in hand with collaboration across different Schools and Faculties. Sometimes, these activities facilitate students’ career development (e.g. collaboration between the Faculties of Economics and Law). The university hosts a competence centre, *Centre of Applied Biosciences Chain of Healthy Food d.o.o. for Research and Development*. The Centre is interdisciplinary and aims to create interface between science, innovation and business actors to increase the competitiveness of the agro-food sector. Other areas of interdisciplinary and entrepreneurial development at the University in Osijek include the development of *ICT in Agriculture*.

Box 5.4. The Centre of Applied Biosciences Chain of Healthy Food, J.J. Strossmayer University in Osijek

The Centre of Applied Biosciences Chain of Healthy Food d.o.o. for Research and Development was established as a non-profit limited company in 2015. Its five founders are: the Faculty of Agriculture, the Faculty of Food Technology, the J.J. Strossmayer University in Osijek, the Faculty of Medicine, the Osijek Agricultural Institute. The mission of the competence centre is to create a functional interface between scientifically-innovative systems and business entities in order to increase the competitiveness of the agro-food sector to the benefit of both the economy and the society as a whole and ensure the sustainability and quality of the scientific system, which in full function of the economy, the public understanding of science, technology and the importance of innovation. The Centre collaborates with various stakeholders including HEIs, entrepreneurial support institutions and business entities.

These examples of locally embedded diverse knowledge exchange activities are highly commendable, but more systematic approaches may be developed by gathering further intelligence and data on the needs of the local and regional economy and societies and by matching the expertise available in their knowledge base. Universities are key sources of spillovers, through which they attract and retain talent in the region. There is a clear link between the presence of highly skilled people and regional growth; the targeting of people with specific skills can help build up a critical mass, which in turn can act as an attractor of other individuals and help new as well as existing businesses.

More in general, Croatian HEIs can build up contacts and intelligence base (e.g. Local economic observatory) to work more efficiently and respond to the needs and demand of business partners, citizens, local and public organizations.

Knowledge exchange through students and curriculum development

Knowledge exchange activities are two-way processes, and often involve students. Companies quite often express their educational needs to HEIs or even engage in the development of curricula or collaborative educations (e.g. dedicated professorships or courses). Students can also influence the way companies work through their dissertation work, placements and research projects.

Many Croatian HEIs - including large and small universities, polytechnics - have developed a variety of innovative knowledge exchange activities by engaging both students and employers, and they are co-developing the curricula to meet the needs of specific industry and the wider society. Many of these practices are commendable:

- At the University J.J. Strossmayer in Osijek, the Faculty of Electrical Engineering, Computer Science and Information Technology (FERIT) has developed a number of interface mechanisms with industry and recently, established a new Automobile study programme attracting key industry partners (Box 5.5);⁴⁰

⁴⁰

https://www.ferit.unios.hr/dokumenti/studenti/dokumenti-o-studijima-i-studiranju/2017-eng-dipl_sv_st_Aut_rac_kom.pdf [03/08/18]

Box 5.5. The University J.J. Strossmayer in Osijek Study Program Automotive Computing and Communications

The Faculty of Electrical Engineering (FERIT) at University J.J. Strossmayer in Osijek initiated discussions with partner companies (especially Institut RT-RK and Rimac Automobili), which resulted in the idea to start a new type of a study programme. The FERIT then invited all partner companies using the web-portal Stup (currently more than 300 companies are registered) so that they could help in creating and developing the new programme. Six companies responded positively, and four of them participated (Yazaki, AVL AST, GlobalLogic, Xylon) in creating the programme. With Institut RT-RK and Rimac Automobili a total of six organisations co-created the new programme. One of the organisations, Institut RT-RK, is located in Osijek, and the programme aims to ensure the graduates will meet the specific knowledge and skills requirements of the automotive industry, as well as provide wider expertise to be employable in the region.

The other five organisations are based in the Zagreb area, but the FERIT aims to actively motivate companies to come to Osijek, employ students (as their possible future employees) and collaborate with the university academics as possible team members in future joint R&D projects. A few months after the start of the study programme, Rimac Automobili came to Osijek to develop cutting-edge technologies encouraged by the cooperation potential with the university – both students and researchers. This is a sign that the new study programme has had a positive impact on the regional development in a wider sense. From October 2017, the study programme started with the first cohort of 15 students. It is planned that the study programme will be delivered in English from 2019 to attract students from abroad. The partner companies participate actively in a variety of forms including guest lectures, offered internships/scholarships/topics for final and master theses. The portal Stup has been effective in publishing and advertising these opportunities.

- The University of Split developed the concept of *Teaching Base*. The Teaching Base enables students to receive training and practice in organizations with which the university has a cooperation agreement. These organisations include business and non-business entities;
- The Velika Gorica Polytechnic has developed collaborations with a variety of actors beyond the academia. These include several ICT and optometry companies (given its study programmes in optometry), the Ministry of Defence, the Ministry of Internal Affairs, the Croatian Red Cross, the Croatian Fire Brigade, the Mountain Rescue Service, the Croatian Armed Forces (for its study programme on Crisis Management) and the Croatian Air Force and Defence as well as Croatian Airlines (for its study programme on Aircraft Maintenance);

All these examples show the need to create university support mechanisms for knowledge exchange activities including staff and students alike. An interesting initiative of this kind developed in the UK is the KTP (Box 5.6).

Box 5.6. Knowledge Transfer Partnerships (KTP), a UK programme to promote university-business collaboration

The Knowledge Transfer Partnerships (KTP) scheme is a UK-wide programme that has been helping businesses for the past 40 years to improve their competitiveness and productivity through the better use of knowledge, technology and skills that reside within the UK HEIs and research organisations. The KTP programmes are partly funded by Innovate UK, the UK government's innovation agency and other government organisations.

Each KTP involves an academic and a business partner, very often an SME, who recruit and jointly supervise an associate (i.e., a recent graduate) who works within a business to deliver a project of strategic importance, also supervised by the academic partner. Each project lasts between 12 and 36 months. KTPs involve cooperation on an R&D project through a formal partnership between a business and a university. KTPs provide businesses with access to support, research and expertise from the university that helps them innovate and grow with tangible outcomes. Recent graduates, as KTP associates, gain hands on business experiences of strategic nature, which enhance their career development.

Source: Adapted from Government of United Kingdom (2019), "Innovate UK: Knowledge Transfer Partnerships", www.ktp.innovateuk.org, accessed in April 2019

Knowledge exchange with wider communities

HEIs find innovative ways of collaborating with a broad range of partners, expanding their research base, primarily through collaboration with the local community, not only via industrial partnerships, but also by collaborating with NGO and public-private organisations (as in the case of many of the HEIs visited: Dubrovnik, Split, Velika Gorica, VERN'). Sometimes HEIs create innovative ways of seeking external funding and expanding knowledge exchange activities for the benefits of scientific, artistic and public interests (e.g. Rijeka).

During the review study visits, a number of good practices in terms of engagement between Croatian HEIs and local communities, NGOs, social enterprises, schools, theatres, professional organisations and associations and policy communities were observed. These knowledge exchange activities are driven not only by academic staff but also by students. Box 5.7 and 5.8 describe some interesting initiatives observed during the OECD study visits: VERN' Island Project and the University of Rijeka Foundation established in 2003 together with the City of Rijeka and the county of Primorsko-Goranska. This Foundation is one of the oldest University Foundation in Croatia. The Foundation is an independent organisation but it fully takes part in the university's strategy development and actions with the focus on the realisation of ideas and projects for the promotion of research and the dissemination of knowledge, the access to education for all, as well as the promotion of scientific excellence.

Box 5.7. Vis Island School, a VERN' Polytechnic campus on a Croatian island

VERN' Polytechnic has established a campus in Vis, an island of Croatia, VERN' Island School by partnering with local authorities (e.g. the town of Vis). The school provides a unique place on a very attractive location in Croatia, where academic and business communities meet. Students from 'VERN, international students, local communities, business investors meet for professional, educational and scientific activities beyond the traditional academic and business surroundings. The school is starting to contribute to the gradual diversification of Vis' economy which is almost totally dependent from tourism. In particular the island and town of Vis gained the opportunity to gradually diversify their development from the total dependence on the tourist season and direct their developmental activities towards the revival of the culture and history of the island. This is happening through academic, business and entrepreneurial activities developed within the parameters of sustainable development.

Box 5.8. The University of Rijeka Foundation

The University of Rijeka Foundation cooperates with the academic community, faculties, public institutions, government, business sector and NGOs on local, national and international level. The main activities of the University of Rijeka Foundation are yearly programmes for the co-financing of the participation at scientific conferences, the organisation of scientific meetings, publishing activities, student activities (students projects and students specialization). Over the 15 years, the Foundation has raised over 9 million KN, carried out a total of 93 tenders, invested almost 10 million KN and supported 2 421 users. The Foundation has awarded 93 excellent scholars and artists (46 men and 47 women) for their outstanding achievements in science, art, teaching and professional work, and public works during the past 15 years. It also carries out a number of programmes and national, regional and EU level, roundtables, forums, workshops, humanitarian, public and volunteering actions and fundraising campaigns in the field of international collaboration, gender equality, sustainable development, education, human rights, youth and philanthropy.

Knowledge exchange – the international and cross-border dimension

As a national science and innovation system of a small-sized country, Croatia needs balanced cooperation and competition between researchers, not only in Croatia but also internationally (see Box 5.9 for the description of an initiative to meet these needs in Scotland). The development of critical mass of research excellence with relevant knowledge exchange activities across national borders is highly recommended. A variety of knowledge exchange networks and mobility mechanisms may help knowledge circulation across borders. The Croatian national authorities should facilitate strategic collaboration across HEIs in terms of identifying areas of international research excellence and developing links with relevant partners.

Box 5.9. Research pooling in Scottish HEIs and knowledge exchange

Scotland has 19 autonomous HEIs, which are funded through the Scottish Funding Council (SFC). The research pooling initiative was created in 2003 to encourage researchers across Scottish higher education to pool their resources and capabilities, and respond to increasing international competition. Individual HEIs in Scotland found the idea of pooling attractive as they felt the need to form 'critical mass of research excellence' in Scotland to address big science issues, and to compete nationally in the UK as well as internationally. It was expected that research pooling initiative would help strengthen Scotland's ability to retain the best research capability including professors and research students from overseas. The initiative started with physics and chemistry and then spread into other discipline areas. Since 2005 the SFC allocated GBP 156 million to 11 research pools, covering: physics; chemistry; engineering; geosciences/environment and society; economics; life sciences; brain imaging; informatics and computer science; Gaelic language and culture; marine science

Research pooling funding was allocated by both the SFC and participating HEIs. The process included opportunities for university departments across Scotland to talk and identify priority research areas and strengthen their capacity for research excellence. The pooling money was used to recruit 'star' researchers, to purchase equipment and facilities, and to fund research students. In 2008, Scottish HEIs increased their share of the "world-class research" in the UK HE sector (Kitagawa, 2010). In collaboration with external partners, including industry, policy makers and local communities, each research pooling initiative has developed their organizational mechanisms in order to integrate knowledge exchange activities into the inter-university research pooling activities. There are 11 research pooling initiatives operating in Scotland while for the majority of pools the original SFC funding has now come to an end. The research pools continue to contribute to Scotland's research outcomes and world leading research and greater innovation in the economy. In 2017/18, the Scottish Government made available, through SFC, GBP 250 000 a year to research pools through new initiatives, "Pools Engagement in European Research (PEER)" and "Postgraduate and Early Career Researcher Exchange (PECRE)" to help them compete for European funding and to support Postgraduate and Early Career Researcher exchanges with Europe, North America, China and India⁴¹.

There are several good practices related to the sharing of knowledge at international level of individual Croatian HEIs that the review team came across during the study visit:

- The University of Rijeka aims to be included within the top 500 European universities, and has committed itself to dynamic development which systematically facilitates mobility and the development of research careers while providing each individual with an opportunity to express their talents and entrepreneurial energy. It has recently established the International Scientific Council (Box 5.11), and is developing strategic international connections with

⁴¹ <http://www.sfc.ac.uk/research/research-pooling/research-pooling.aspx> [07/08/18]

likeminded European universities, particularly in neighbouring countries (e.g. Italy, Slovenia).

- The University of Dubrovnik is active in terms of bringing in international faculty members and students in their strategic areas of research and engagement (e.g. aquaculture). The university is developing an organizational infrastructure to promote and send their students for study abroad including internships.
- The polytechnics (e.g. Zagreb and VERN' Polytechnic) seem to be active in Erasmus programmes and utilize international internship programmes.
- The University J.J. Strossmayer in Osijek is involved in cross-border collaboration with Hungary on renewable energies (Box 5.10).

In order to further develop and scale-up these international mobility opportunities, HEIs need to strengthen the infrastructure, particularly by investing in centralized support mechanisms.

Box 5.10. Croatian-Hungarian collaboration on renewable energy sources

Renewable Energy Sources Osijek Ltd. (OIEO) was established in 2014 as a result of the cross - border project "Croatian - Hungary Renewable Energy Sources" (CHREN). Founders of the Company Renewable Energy Sources Osijek Ltd. are the University J.J. Strossmayer in Osijek and the City of Osijek, sharing the equity of the organization (60% and 40%). The CHREN project included: the Agricultural Faculty of Osijek, the Regional Development Agency of Slavonia and Baranja, the Association of EU Centers, and the Fenntartható Fejlesztési Egység and the European Foundation from Hungary.

The research centre for renewable energy sources through the production of electricity through a biogas plant will directly have an effect on the greater use of renewable energy sources in the Osijek-Baranja County and indirectly generate revenues from the release of the electricity generated in the network and invest in scientific research as a basis for development and progress.

Finally it is worth noting that there are projects that support scientific research collaboration across neighbouring regions across national borders, often thanks to European Union funding. Student and staff exchange is a primary vehicle to facilitate international links and build relationships. For instance, at the Croatian HEIs, Erasmus mobility schemes are used to create international internship opportunity for students. There is an increasing awareness that to reverse the migration of the highly-skilled workers, Croatia should not only improve conditions for researchers – for example, with better wages, infrastructure, and stability, and well-functioning business career prospects – but also address, the general environment and enabling conditions (World Bank 2013). There is a role for HEIs to play in such long term national cultural shift, and internationalization of knowledge exchange activities is one of the key strategic areas for such long term cultural transformation.

Roles of University Councils in guiding knowledge exchange activities

HEIs have established a variety of governing bodies that advice and provide strategic directions to the HEIs' specific activities including knowledge exchange activities. Some

of the HEIs visited during the OECD study visits have established a formal governance structure that aims to oversee the HEIs' relationships with the wider society. Sometime named as the Economic Council, such a body interacts with a wide range of external partners and stakeholders at the strategic level. Some examples include:

- The Velika Gorica Polytechnic - The Economic Council was established in 2015 to set the strategic goals of the HEI with key external stakeholders. Following on this strategic move, the HEI has recently set up its strategic objectives, identifying the metrics for each of the strategic activities;
- The University of Rijeka has established a University Council (SC) with 12 members: 6 members are appointed by the Senate (5 are from university researchers or professors; 1 is from the students); 2 members are appointed by the Ministry of Science and Education; 2 members are appointed by the Croatian Chambers of Commerce, and the remaining 2 are appointed by the local government where the university is located. A new body, the UniRi International Scientific Council (ISC), established in early 2018, consists of ten Croatian scientists with international scientific track record currently working at universities around the world (Box 5.11);
- In Dubrovnik, the University Council works as an interface with external stakeholders at the strategic level. This includes mayors of the city and the county. The university has a strong link with the Chamber of Commerce, particularly in terms of the strategic development of tourism strategies.

Strategic and high-level engagement with a wide range of external partners and stakeholders, locally, nationally and internationally, helps identify the future strategic directions of the HEIs.

Box 5.11. The International Scientific Council at the University of Rijeka

The International Scientific Council (ISC) of the University of Rijeka consists of ten internationally reputed Croatian scientists currently working at universities around the world.

The role of the ISC is to promote and suggest the UniRi management the following strategic directions:

- revitalisation following the principles of openness, flexibility, free idea flow, strong European links, attractiveness for the best students, junior researchers and senior research staff;
- research competitiveness and relevance as well as international visibility together with a strong push towards European criteria and positive experience sharing from abroad to Rijeka, adapting it to the local context;
- resources and programmes to be focused on quality; identifying and promoting the best researchers and allowing them to spend a greater share of their time on research;
- internationalisation and networking of successful research groups at UniRi into competitive international programmes accompanied by increasing the number of conferences and events held in Rijeka with participation of the world's leading scientists; integration of UniRI into the European University Network to be established by 2024;
- investment in and dedicated support to young researchers/postdocs allowing them partial waivers from teaching obligations in order to study the application of new technologies at other institutions;
- promoting inter-disciplinarity;
- development of state-of-the-art study programmes (including new ones like architecture, transition processes, etc.); establishment of doctoral schools especially in English as well as joint studies with institutions from the world's most developed countries (especially in the fields where Rijeka can offer relevant knowledge to PhD students worldwide);
- innovation and networking/knowledge transfer from and to the industry, accompanied by active, open communication between researchers and industry;
- active participation in the project Rijeka European capital of culture 2020;
- increase in financing of research and higher education from the state budget;
- defining a new UniRi strategy accompanied by full transparency and accountability of the UniRi management and other stakeholders for the achievement of goals set within and readiness to critically analyse the work done in the previous period.

The ISC will help position the university's strategic direction regarding not only research and education but also in terms of its engagement with the wider society and stakeholders from international perspectives.

Conclusion and policy recommendations

HEIs co-produce knowledge with a wide range of knowledge exchange partners, not only businesses but also civic and community organisations, and government bodies. Knowledge exchange encompasses a broad range of activities which go beyond research commercialization (e.g. technology transfer, academic spin-offs), and may have social and cultural impacts. The relationships may be transaction-based (e.g. licensing of IP) or trust-based. Both academics and students play key roles in knowledge exchange processes. Knowledge exchange takes place at many different stages of research and education, and often in synergy with one or the other. Figure 5.1 schematically summarises characteristics of some of these activities.

In the Croatian context, it is possible to recognize a broad variety in terms of the types of HEIs, their different sizes, organizational and governance design and structures, and the nature of knowledge exchange activities, with linkages to different teaching and research activities. The diversity of HEIs in Croatia influences the structure and organizations of knowledge exchange activities at each of the HEIs and its surrounding ecosystems, interacting not only via research but also through teaching and student activities.

The following recommendations offer ways to improve the current system in a number of areas.

Create incentive mechanisms for knowledge exchange

There should be clear incentives for knowledge exchange activities both at the national higher education policy level and individual institutional level. The national employment restrictions for public universities regulated by the Ministry of Science and Education on academic workload need reconsideration. These may go beyond financial incentives related to IPRs. Knowledge exchange activities need to be recognized as part of the academic reward and promotion criteria if these are considered to be a key part of the HE missions and activities.

Allocate sustainable long-term national funding for knowledge exchange activities and programmes

National authorities need to consider the establishment of longer term funding dedicated to knowledge exchange development at the institutional level. In general, this may mean achieving a better balance between the institutional funding, which facilitates funding stability and may be linked to institutional strategies, and competitive project-based grant funding, which fosters competition in science, is needed. There have been a number of initiatives and programmes for a short duration, but these initiatives tend to be discontinued after the initial funding sources, often from international organisations (EU, World Bank, etc.) end. To support monitoring and evaluation of these funding streams, the Ministry of Science and Education needs to build on national and international data-sets to capture knowledge exchanges and mobility of researchers and graduates to enable strategic planning and resource allocation.

Strengthen R&D intensity, especially in the business sector, to strengthen the demand for knowledge exchange activities

The low levels of R&D activities by the Croatian business sector is a key issue for the development of a mature Croatian innovation system. If the appetite for cooperation with

HEIs is limited, it is difficult for HEIs to establish long-term collaborations with the business sector. A way to promote innovation in the business sector is to establish well-functioning innovation agencies. Innovation agencies (such former BICRO; current HAMAG-BICRO) need to be reviewed and strengthened. On their side, HEIs should take a proactive approach in terms of identifying the needs of industry and the society, aligning research, training and creating new curriculum.

Promote the internationalisation of knowledge exchange strategies

National policy makers should facilitate strategic collaboration across HEIs to identify areas of international research excellence and developing links with knowledge exchange partners. By facilitating international research mobility and internship opportunities for researchers and students, Croatia can benefit from international excellence networks and knowledge exchange opportunities. Croatian alumni and scientists abroad can be a useful resource.

Develop a dynamic knowledge exchange ecosystem and intelligence base

HEIs need to embed knowledge exchange strategies and activities through different organizational mechanisms and to build trust and sustainable relationships with different partners. The curriculum design need to be flexible to reflect the needs of external partners. Students are essential knowledge exchange agents. Interdisciplinary research collaboration and co-creation of knowledge with industry partners help create new demands and innovation. HEIs should promote cross-faculty collaboration and networks with funders and clients. Appropriate institutional mechanisms and intermediary organizations to enable such innovation ecosystem need to be created or, when already existing, strengthened. The HEIs can build up contacts and intelligence base (e.g. Local economic observatory) to work more efficiently and respond to the needs and demand of business partners, citizens, local and public organizations. Strategic and high-level engagement with a wide range of external partners and stakeholders, locally, nationally and internationally, helps identify the future strategic directions of the HEIs.

Develop the appropriate organizational structure for knowledge exchange

There is a need to create or strengthen university central support organizations for knowledge exchange activities including staff and students alike. These include TTOs, Student Career Centres, SME support centres, and entrepreneurship support centres. HEIs should be able to plan selected knowledge exchange activities as part of their core institutional strategies. Strategic resource acquisition planning and developing of knowledge exchange activities need to be carried out at the university central level and, particularly at large and non/semi-integrated HEIs, in coordination with the Faculty level, to avoid fragmentation of resources. There must be national level mechanisms to help develop such structures. At newer HEIs, especially some polytechnics, there are a number of bottom-up knowledge exchange initiatives connecting students and employers. In order to make these good practices sustainable, the combination of strategic support at the central level, and bottom-up networks and interactions appear to be needed.

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Annex 5.A. Annex

Table 5.A.1. Knowledge exchange infrastructure (Universities with TTOs)

| HEIs | University structure | TTO structure | |
|----------------------|----------------------|------------------------------------|---|
| University of Split | Non-integrated | University TTO | Technology Transfer Office (TTO) established in 2007 within Department of Physics at the Faculty of Mathematics and Sciences while at the end of 2008 became part of Enterprise Europe Network (EEN) of Croatia. Through the Network activities the TTO acted as a regional partner and helped entrepreneurs and scientists from Dalmatian region to find international partners for technology transfer and to increase innovation and competitiveness. The TTO received the World Bank funded proof of concept programme managed by HAMAG-BICRO. In 2010, it became a part of the Centre for Scientific and Technological development of the University of Split. Recently it has been integrated as part of Tech transfer and Project office. |
| University of Rijeka | Non-integrated | University TTO as part of S&T Park | The <i>Step Ri</i> Science and Technology Park of the University of Rijeka was established in 2008 by the University in order to become the premier science and technology hub, facilitating the commercialization of R&D and to foster cooperation between the scientific community and industry. TTO was established in March 2009 within Science and Technology Project (STP) financed by the World Bank. There is also a “satellite” TTO at Faculty of Medicine, Centre of Proteomics, with a role in supporting the central TTO in technology transfer activities for technologies developed at Faculty of Medicine. The <i>STEP Ri</i> provides a number of different functions related to innovation, entrepreneurship and SME support, as well as EU project management and business consultancy. |
| University of Zagreb | Non-integrated | University TTO and Faculty TTOs | The University level TTO was created in January 2008 with the support from the EU funding, but when the funding stopped, the TTO activities had to be significantly decreased. It was re-organized into the Centre for Research, Development and Technology Transfer in 2010 by coordinating activities of the University’s Research office and Technology Transfer Office. Still the scope and scale of the TTO at the university level is limited |

| | | | |
|---------------------------------------|----------------|------------------------------|---|
| | | | (2 staff). In addition to the University level TTO, the university of Zagreb has four different TTOs at the Faculty level (Medicine, Electrical Engineering and Computing, Mechanical Engineering, and Naval Architecture, Traffic and Transport Sciences). Some of the Faculty level TTOs precede the University one. They substantially vary in terms of their business models and resources available. |
| University J.J. Strossmayer in Osijek | Non-integrated | University – City-County TTO | The University, along with the City of Osijek and the Osijek-Baranja County set up <i>TERA Technopolis</i> as a joint venture in 2002. The activities of TERA Technopolis especially focuses on incubator facilities and the development of technologies (products, services and processing), developing entrepreneurship in the region, and technology transfer and the commercialization of publicly funded research conducted by the University of Osijek and the protection of intellectual property. |

Table 5.A.2. Knowledge exchange infrastructure (HEIs without TTOs)

| | | | |
|-----------------------------|----------------------|--|---|
| The University of Dubrovnik | Integrated | | The University has been encouraging academics to apply for research projects and encourage commercial and wider knowledge exchange activities. There have been already a number of knowledge exchange activities occurring at the Faculty level including aquaculture department working with local firms and maritime and shipping department working closely with the sector. In terms of student internship, the mechanisms to support these at the central level including Erasmus mobility schemes has been developed. However, there is no university organizational structure to serve as the business interface and support academic entrepreneurship activities. |
| Velika Gorica | Polytechnic, private | | The polytechnic has a wide range of industry interactions through employer engagement. At Velika Gorica, there are a number of student-centred knowledge exchange activities, but there is no centralised organizational support mechanisms. |
| VERN' | Polytechnic, private | | VERN', currently, a private polytechnic, has taken pragmatic approach in building a wide range of interface with employers, businesses and entrepreneurs and co-delivering programmes. |
| Zagreb Polytechnic | Polytechnic, public | | Zagreb Polytechnic is a public polytechnic university that provides education and highly industry relevant training in various fields of engineering and applied sciences. There is no |

centralised organizational support mechanisms at the university level.
