

Chapter 3. Knowledge exchange and collaboration in Italy

Knowledge exchange between higher education institutions (HEIs) and other stakeholders is an important catalyst for innovation, the advancement of teaching and research, and local development. It is a continuous and bidirectional process, which includes the stimulation and direct application and exploitation of knowledge for the benefit of the social, cultural and economic development of society. This chapter begins with an introduction discussing theoretical aspects of knowledge exchange – including university-industry collaborations – followed by a section describing the Italian case and discussing challenges and opportunities. Importantly, the chapter benefits from information gathered in a stakeholder workshop held at the University of Milan “Bicocca” in May 2019. Policy recommendations conclude the chapter.

Knowledge exchange: An introduction

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 these activities at the national and subnational policy levels, as well within the university, exist. These mechanisms include, for instance, a well-designed framework for intellectual property rights (IPRs), national funding stream designated to promote knowledge exchange activities, innovation vouchers to encourage businesses to work with HEIs, and the reward and promotion criteria for academics to engage with different knowledge users. The scope and activities of knowledge exchange are thus very broad.

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

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

University-industry collaboration is an important channel of knowledge exchange

University-industry collaboration is important to foster innovation and the diffusion of innovation in productive systems. A large body of literature discusses practices and methods (OECD, 2013; Jones-Evans et al., 1999; Galán-Muros and Plewa, 2016; Vedovello, 1997; EU 2018). The report of the Danish think-tank DEA (2016) gives an overview of the literature on practices, highlighting that while a lot of emphasis has been put on technology transfer, many other practices of collaboration exist beyond technology transfer (Table 3.1). Studies on the consequences of university-industry collaboration discuss the impact both on companies' performance (Davey, Plewa and Muros, 2014) and on academics' careers (Perkmann et al., 2013). Finally, collaboration provides researchers with funding but also with first-hand information and data about industry, especially if one considers that many companies in the market own more data than universities (The Guardian, 2017).

The collaboration between universities and firms, however, is not straightforward and several challenges may emerge. These entities have different functions and missions and also their “languages” can be different. These characteristics can affect their ability and their propensity to collaboration (Boschma, 2005). Firms, and especially small firms, may lack the institutional capacity to generate functional linkages with universities.

Concerning HEIs, lack of co-ordination between institutional and individual engagement strategies hinders collaboration. In other cases, institutional support and rules may cause cumbersome bureaucracy, while many researchers would rather develop spontaneous

relations and collaboration with business (Etzkowitz et al., 2019; Centobelli, Cerchione and Esposito, 2018).

Table 3.1. Different mechanisms of university-industry collaboration

From the most popularised (top lines) to the less popularised (bottom lines)

Most popularised	1. Technology transfer (sale & licencing of IPR, spinouts)
	2. Collaborative research and development (R&D)
	3. Contract research
	4. Consulting
	5. Collaboration on teaching and training
	6. Sponsored research, gifts and endowments
	7. Informal meetings, advice and exchanges
	8. Mobility of staff
Less popularised	9. Other dissemination activities

Source: Adapted from DEA (2016), “What lies beneath the surface? A review of academic and policy studies on collaboration between public research and private firms”, http://www.dea.nu/sites/dea.nu/files/baggrundsrapport_endelig.pdf.

Competing incentives within HEIs represent another challenge to collaboration. The imperative to publish versus the goal to have a practical impact and maintain collaboration alive is one of them. In many OECD countries, career evaluation and progress are often based on publications and research excellence. This system of incentives may become an obstacle to engagement outside academia, which is time-consuming and implies the development of new types of skills (Etzkowitz et al., 2000).

There are important systemic framework conditions that can facilitate collaboration, including at the national and regional levels. For example, national laws and regulations have an obvious impact on academic entrepreneurship and engagement. National frameworks affect the ease of doing business in a given country. In the same vein, regulation affects the way in which HEIs co-operate with companies, including start-ups. The capacity of HEIs to engage with the economy and society depends also on regional and local characteristics. A university is more prone to engage with industry and society in well-developed entrepreneurship and innovation ecosystems where the absorptive capacity of firms is high.

In general, due to the importance of academic engagement, policymakers in OECD countries look for practices to facilitate and support university-industry collaboration. Vinnova, the national innovation agency in Sweden, represents a well-known example of a governmental agency promoting this type of collaboration (Box 3.1).

Box 3.1. Vinnova – Financing research with a collaborative mission

Vinnova is a Swedish agency under the Ministry of Enterprise and Innovation. With its offices in Stockholm and Brussels, Vinnova is also the Swedish contact for the European Union (EU) Framework Programme for Research and Innovation. The agency has around 200 employees and generates long-term visions and strategies for the Swedish research and innovation system. Vinnova encourages the collaboration between universities, industry, public organisations, civil society and others, with a view to international diversification.

In fulfilling its mandate to support innovation, Vinnova finances early-stage innovation ideas. These ideas often entail great risk and require government aid. Due to the support of the agency, businesses and other organisations are able to test new ideas before they become profitable. This promotes the general propensity towards innovation in the system.

Vinnova has an annual budget of approximately EUR 280 million, most of which is distributed to a selection of the many funding proposals submitted. Funded projects are continuously monitored.

Innovation has a better chance when knowledge and skills in different fields can interact and create interdisciplinary new fields. This is why Vinnova focuses on stimulating cross-collaborations among universities, research institutions, industry and public services. In addition, Vinnova supports research to identify solutions to emerging social challenges, such as those of an ageing population or energy transition and the sustainability agenda.

Source: Vinnova (n.d.), *Homepage*, www.vinnova.se/en/ (accessed on 15 February 2019).

Knowledge exchange in the Italian context

Italian HEIs have developed a broad understanding of knowledge exchange, which goes well beyond the traditional emphasis on technology and research linkages with the business sector, start-ups and spin-offs. The country abounds with examples in which knowledge exchange acquires a broad meaning and scope. These include: the strong emphasis that several case-study HEIs have put on Sustainable Development Goals (SDGs); initiatives to facilitate the social inclusion of refugees in Italy by providing them with training; and, capitalising on the outstanding cultural heritage of Italy, many collaborations and partnerships with museums, theatres, opera houses, archaeological sites and other cultural institutions.

Since Italy is one of the world's leading economies, a manufacturing powerhouse and home to a vast amount of cultural and natural amenities, there is scope to increase the general level of academic engagement. On average, Italian universities display a low production of patents and spin-offs compared to other European universities (OECD, 2017a). Although the majority of universities have a Technology Transfer Office, only about one-third of them have an incubator and a few have developed partnerships with scientific parks.

The Italian case is featured by some systemic challenges – such as the dominant role of small- and medium-sized enterprises (SMEs) in the national economy – and others that depend on the ecosystems in which HEIs operate – for example, the large regional disparities in terms of household income and productivity (OECD, 2018). Therefore, besides national indicators and averages, it is also important to look at academic engagement from an eco-systemic point of view.

Differences among regional ecosystems affect the capacity of universities to develop linkages with industry and society. Universities active in regions where there is a high

density of firms, economic activities and an urban hub tend to be more responsive to the stimuli of their ecosystems. Conversely, in regions where there are fewer resources, fewer firms and local companies are less R&D-intensive, it is much more difficult for HEIs to establish long-term strategic collaborations in education, research and innovation.

Key national and regional policies supporting knowledge exchange and collaboration

Mirroring the increasing demand for innovation and skills in the country, national authorities have put in place several policies to support academic engagement over the last decade. Among others, there are the industrial PhD programmes, implemented with the support of the Italian employer association, Confindustria, that aim to promote collaboration between universities and firms at the doctoral level. The national plan Industry 4.0 (or Enterprise 4.0) represents another important example of promoting stronger university-industry technological partnerships (OECD, 2017a). Industry 4.0 connects with initiatives such as the National Technological Clusters and competency centres, which Italian stakeholders consider positively in terms of their capacity to promote entrepreneurial education and start-ups. The following sections illustrate some of the practices to promote knowledge exchange and collaboration in the Italian higher education system.

FIRST and National Technological Clusters (CTN)

The Fund for Investment in Scientific and Technological Research (FIRST) and the National Technological Clusters (CTN) are among the main policy initiatives the Ministry of Education, Universities and Research (MIUR) has put in place to promote market-oriented research.

MIUR – and in particular the Directorate-General for Research Co-ordination and Development – created FIRST in 2007 by merging different funds that were all supporting the linkage between university research and industry.¹ In particular FIRST:

- Provides financial support to basic research.
- Supports applied research (industrial research), including pilot projects in some specific industries.
- Generates legal frameworks to facilitate procurement in connection with R&D focusing on societal challenges.
- Promotes research to generate social innovation.
- Finances advanced training, technology transfer centres and spin-offs for the development of technological clusters in public-private co-operation.
- Connects to national initiatives supporting basic and industrial research, in connection with EU-funded programmes.
- Facilitates the use of research results in an industrial context.

Since 2017, FIRST allocates funds to the National Technological Cluster (CTN) initiative, which represents a policy favouring public-public and public-private collaboration. Consistently with Horizon 2020 priorities, the objective of CTNs to gather together critical skills from the productive sector, the research system and the public sector – both at the national and regional levels – to define shared goals for the respective research agendas and co-ordinate their implementation (roadmaps).

The Rectors' Conference of Italy (CRUI), the National Research Council (CNR) and the Italian industrialist association (Confindustria) have been implementing a consortium with

the aim to generate more economic and social value from academic research and technology transfer. MIUR has supported this initiative with an initial instalment of EUR 4 million. The consortium should protect and strengthen intellectual properties and patents, and facilitate the transfer of knowledge and research spurring from universities and research entities.

Industrial PhD and PhD ITalents

The Italian higher education system has been promoting the use of high-level skills in the productive sector. Policies have been supporting innovative PhDs and project PhD ITalents. The former are PhD programmes implemented in collaboration with a firm that generates a research opportunity and employment experience for the PhD candidate. The latter is a policy that promotes the employment of PhD graduates in firms looking to improve their R&D capacity.

Innovative doctoral programmes, introduced by the National Research Programme 2015-20, are based on three main features: international, inter-sectoral and interdisciplinary. In particular, inter-sectoral industrial programmes (which include “industrial doctorates”) have to fill at least one of the following requirements:

- Programmes are based on co-operation with research institutes, enterprises or other entities carrying out R&D activities.
- Programmes are selected within international or European programmes related to university-business co-operation.
- Programmes are linked with Industria 4.0.
- Programmes are based on agreements with other entities on activities related to research and transfer of innovation, with joint supervision of candidates.

PhD ITalents is a project that promotes linkages between PhD programmes and R&D activities in firms, similar to the ones developed in other OECD countries (Box 3.2). The project is financed by MIUR and is managed by the CRUI Foundation, in partnership with the Italian industrialist association, Confindustria. PhD ITalents connects with different European strategies, such as the Innovation Union (European Commission, 2010) and the national strategies for the innovation of doctoral education. The project aims to generate a virtuous cycle of “guidance-information-placement” in which PhD students can go to carry out their research activities in the R&D departments of partner companies. The programme provides co-funding to firms hiring PhD students on a three-year contract. In particular, the public sector co-finances 80% of the cost in the first year. Then 60% in the second year and 50% in the last year of the contract period.

PhD ITalents has been a successful initiative, as illustrated by the fact that the number of firms involved in the project was much larger than expected. When the CRUI Foundation launched the project in 2016, it received 682 applications from Italian firms including many SMEs. A total of 450 firms passed the first selection and gained the possibility to submit their job openings to PhD candidates. Only 258, in 2017, could identify a candidate of their interest. Interestingly, the share of SMEs in the pool of firms has remained quite stable throughout the different levels of the selection process. Finally, about a third of the hiring firms offered PhD students an open-end contract, instead of a fixed-term three-year contract.

Based on information collected in a stakeholder workshop held in Italy in May 2019, Italian stakeholders have mixed views on the collaboration between universities and firms at the doctoral level.² For examples, while recognising the importance and the potential of the policy, some firms highlight the need for improved collaboration with universities in the

design and implementation of the doctoral programmes. One area for improvement is the twofold relation PhD candidates have with the firm hosting them and with the university from which they are graduating. These graduate students face the challenge of responding to the research needs of the company hosting them, while preserving the research standard of their doctoral education. In the current system, PhD candidates have to handle a twofold relation: one with the firm hosting them and the other with the university from which they are graduating. According to business stakeholders, this limits their capacity to respond to the research needs of the company in which they operate. Furthermore, while industrial PhDs are a good instrument to underpin collaboration between universities and large firms, it proves difficult to use them with small firms, which are those that would benefit the most from innovation and R&D activities. The same applies to PhD graduates, who tend to be overqualified for the skills needs emerging from the Italian productive sector (OECD, 2017).

Box 3.2. Industrial doctoral programmes in France – CIFRE

In France, CIFRE (*Conventions industrielles de formation par la recherche*, or industrial research training agreements) are industrial doctoral programmes that were launched in the early 1980s to bridge the gap between academia and the private sector. CIFRE have been working for several decades now and implemented in all disciplines (including social sciences and humanities). They have had quite successful results: in 2016, the employment rate after graduation was of more than 85% and CIFRE doctorate holders tended to have higher salaries than the rest of the population of doctorate holders.

The principle is as follows: the doctoral student, enrolled at a research laboratory, is hired by a company to conduct research on a project that is considered as strategic for the socioeconomic development of the company. The agreement sets terms on working conditions (salary, 100% of working time dedicated to research, academic and professional training, etc.), intellectual property, etc. Companies get subsidies and tax exemptions to hire the doctoral student through CIFRE.

Source: ANRT, cifre@anrt.asso.fr.

Collaboration in the agro-food supply chain

Agro-food is an important industrial sector in Italy and generates many opportunities for collaboration between HEIs and firms. For example, Italian HEIs such as the University of Siena in Tuscany and the University of Parma in Emilia-Romagna have developed specific activities and institutions to collaborate with firms in agro-business and improve the competitiveness of their ecosystem (Box 3.3).

Support to the agro-business is also systemic. Inspired by the positive experience of industrial PhDs and ITalents, the Ministry of Education has developed a programme to connect PhD programmes and the agro-food sector. The project aims to modernise the agriculture supply chain and improve the competitiveness of firms operating in this sector. The ministry has developed FAI Lab in co-operation with the largest farmer association in Italy (*Coldiretti*). The project promotes the placement of students enrolled in PhD programmes in food and sustainable development in firms and institutions operating in the agricultural and agro-food sector. The selection process and the call for companies are currently underway.

Box 3.3. Italian HEIs collaborating with the agro-food industry in their ecosystem

The University of Siena

The University of Siena is located in Tuscany, which is highly specialised in agribusiness. The region tops the national rankings in terms of certified geographical indications and traditional specialities, known as protected designation of origin (PDO), protected geographical indication (PGI) and traditional specialities guaranteed (TSG). Within this context, the University of Siena has been developing a series of projects to collaborate with agri-food firms and help them improve productivity and international visibility. Among others, the University of Siena Santa Chiara Lab (SCL) hosts the Italian Secretariat of PRIMA, a major Euro-Mediterranean research and innovation programme on food systems and water resources. This makes SCL a national and local hub in knowledge exchange in the agri-food sector.

Within this context, the university launched the first Italian professional bachelor's programme (*Laurea professionalizzante*) in agribusiness, in 2018. The professional bachelor's will generate skilled workers and managers for agribusiness. Study programmes will be interdisciplinary and encompass mathematics, statistics, biology, chemistry, as well as economic and legal disciplines in the agricultural and agribusiness sector.

The University of Parma

The University of Parma is located in the core of the so-called Italian food valley. In Emilia-Romagna, there are 44 PDO- and PGI-certified products – the highest number in Europe. The region is home to renowned products/brands including Parmigiano Reggiano (Parmesan cheese), Prosciutto di Parma (Parma ham) and Aceto balsamico di Modena (balsamic vinegar from Modena). The city is also home of the European Food Safety Authority (EFSA).

This regional hyper-specialisation in the agro-food supply chain has affected the three university missions and spurred their integration. Within this context, the University of Parma has pioneered a university degree in agri-food economics and has created a research centre – Parma Technopole – that has developed new technologies and methods to promote organic vegetal and animal productions. The co-operation with firms, including those active in the agro-food industry, happens through several channels. For instance, the University of Parma has created a co-ordination table TACRI (*Tavolo di Coordinamento Della Ricerca Industriale di Ateneo*) involving industrialist associations, public research institutes and the university's technology transfer offices (TTO). TACRI centralises and brokers all the requests for collaboration coming from the productive sector, including from the agro-food industry.

Note: The University of Siena was one of the 11 case studies selected by the OECD and Italian authorities in the framework of the present review. Representatives from the University of Parma participated in the stakeholder workshop held in Milan (Bicocca University) on May 2019.

Source: gonews.it (2019), “Delegazione toscana di Coldiretti al Tuttofood: “Agribusiness filiera chiave”, <https://www.gonews.it/2019/05/07/delegazione-toscana-di-coldiretti-al-tuttofood-agribusiness-filiera-chiave/> (accessed on 2 June 2019).

Innovation Flow

To promote the interaction between public research and pharmaceutical companies, the Italian Society of Pharmacology (SIF) and the Italian Association of pharmaceutical

companies (Farindustria) have created Innovation Flow. Researchers active in the life science sector have the opportunity to publish their works on the Innovation Flow web portal and make them visible to companies that can assess opportunities for co-operation and R&D investment.

To promote this project, the University-Business Observatory of the CRUI Foundation has created a specific working group that promotes the visibility of the web portal. The working group co-operates with Italian universities to promote the use of the Innovation Flow platform by researchers and technology transfer offices.

National Plan Enterprise 4.0

The National Plan Industria 4.0, now known as Enterprise (*Impresa*) 4.0, is a large-scale policy initiative promoting innovation, skills and digital technologies in Italy (OECD, 2017a; 2017b). Enterprise 4.0 provides firms with assistance for investments, digitalisation of production processes, training and the development of new products and processes. Enterprise 4.0 aims also to reduce the systemic uncertainty that negatively affects the investment propensity in innovation of the Italian private sector.

To achieve these results, the policy initiative has put in place a series of tools and instruments. These include incentives for technological acquisitions, R&D tax credits, super- and hyper-depreciation allowance to facilitate the acquisition of digital machinery tools, tax incentives for training activities in the digital technologies, credit schemes for SMEs, the creation of digital innovation hubs and competency centres (OECD, 2017).

Competency centres are very important for HEI “engagement”. They are public-private partnerships providing technology transfer services, guidance and training on technologies enabling the Enterprise 4.0 paradigm.

These centres specialise in different technology supply chains and involve networks of universities, acting as providers of R&D capabilities, training and digital awareness. Within competency centres, universities work together with the private sector offering technology consulting to firms, including SMEs, launching and accelerating projects and technological development, co-ordinating with European competency centres.

The Italian government has allocated an envelope of about EUR 73 million to this policy initiative promoting the creation of 8 competency centres across the country. These centres are in the process of being established, involving a total of more than 70 universities and research centres and almost 500 companies. All competency centres, with the exception of one, which is associated with the National Centre for Research, will be located in one university that will act as the hub of the network of HEIs connected with that specific centre/technological area. The Italian HEI community has great expectation about the impact of competency centres on productive ecosystems and on their entrepreneurial and innovation agenda. In general, Italian HEIs consider with great favour the Enterprise 4.0 policy initiative.

In particular, the competency centres that are about to open or have just started functioning are the following:

- Manufacturing 4.0 @ Polytechnic of Turin.
- Made in Italy 4.0 @ Polytechnic of Milan (Box X).
- Big Data Innovation & Research EXcellence (BI-REX) @ University of Bologna.

- Advanced Robotics and enabling digital Technologies & Systems 4.0 (ARTES 4.0) @ Scuola Superiore Sant’Anna of Pisa.
- Social network, Mobile platforms & Apps, Advanced Analytics and Big Data, Cloud, Internet of Things (SMACT) @ University of Padua.
- Industry 4.0 @ University of Naples “Federico II”.
- Security and optimisation of strategic infrastructures 4.0 (START 4.0) @ CNR.
- Cyber Security (Cyber 4.0) @ University of Rome “La Sapienza”.

Box 3.4. “Made in Italy 4.0” competence centre – Politecnico di Milano

“Made in Italy 4.0” aims to provide businesses, especially SMEs, with the necessary tools (orientation, training, technology transfer, co-design) to face the digitalisation of production processes. It currently involves 39 companies (technology providers, system integrators, consultants, training experts and manufacturing industries) and 4 universities, namely Politecnico Milano, the University of Bergamo, the University of Brescia and the University of Pavia.

The project foresees a contribution from the partners, in terms of investments in infrastructure, transfer of equipment and the provision of qualified personnel, of over EUR 20 million in total over the first 3 years, with the aim to be financially self-sustaining after 5 years. The chosen location, the Bovisa district, is already characterised by the presence of the Joint Platform just inaugurated with the Tsinghua University of Beijing and PoliHub, the accelerator of the Milan Polytechnic, which currently hosts more than 100 start-up companies.

The competency centre is not a university research lab, but a hub of innovation in which companies share experiences and technologies on Industry 4.0 for advanced manufacturing by carrying out training activities and implementing joint research and innovation projects. A central target is to contribute to the recovery of key sectors of the Italian economy. At the same time, the universities involved should benefit from the interaction of companies by gaining input for research needs and entrepreneurial know-how from the business sector.

Note: The Polytechnic of Milan was one of the 11 case studies selected by the OECD and Italian authorities in the framework of the present review.

Source: Industria Italiana (2018), “Prendono forma i Competence Center, e Milano è in prima linea”, <https://www.industriaitaliana.it/prendono-forma-i-competence-center-e-milano-e-in-prima-linea/> (accessed on 28 February 2018).

Regional initiatives supporting knowledge exchange and collaboration

Regional governments are actively supporting the entrepreneurial and innovation agenda of HEIs. Some regions have put in place a broad range of programmes and initiatives to strengthen knowledge exchange between the university and local stakeholders. In some cases, the co-operation between regional authorities and universities has been focusing on promoting regional development. Universities represent a reservoir of capabilities and technical support, especially in southern regions.

Another area in which regional government have played an important role is that of ISCED level 5 tertiary education. Since 2010, Italy has been developing two-year professional/vocational tertiary education – *Istituti Tecnici Superiori* (ITS), a sort of community college. Regional governments are responsible for vocational educational and

training. In some regions, such as Piedmont, the Polytechnic of Turin, regional authorities and industrialist associations have been co-operating to promote the creation of integrated higher education pathways between ITS and professional bachelor's programmes in the Polytechnic of Turin. The aim is to provide regional manufacturing companies with skills that help them make the most of digital technologies. This collaboration provides university students with the possibility to use ITS laboratories, which are equipped with modern machinery and tools, due to the collaboration between the latter and local manufacturing companies (Box 3.5).

Box 3.5. Integrating professional bachelor's programmes with ISCED level 5 institutions (ITS): The experience of the Polytechnic of Turin

The co-operation between the Polytechnic of Turin and the regional government of Piedmont

The Polytechnic of Turin is experimenting the possibility to generate pathways between ISCED level 5 HEIs, called Technical Higher Institutions (*Instituti Tecnici Superiori*), and the professional bachelor's programme (*Laurea professionalizzante*), a new university degree (ISCED level 6) introduced in the 2018/19 academic year.

The Polytechnic of Turin is an important regional actor. It co-operates with other institutional actors such as the regional government of Piedmont and the City of Turin. Taking advantage of its institutional capital, the polytechnic has been co-ordinating a regional round table to discuss the harmonisation of ITS curricula with its new professional bachelor's degree. The round table involves all the regional ITS specialised in manufacturing vocational education and training (VET), regional and local authorities and other stakeholders, such as the regional branch of the national industrialist association, Confindustria.

Regional ITS involved in this policy dialogue should update their curricula to make them modular with the professional bachelor's degree offered by the Polytechnic of Turin. This will allow ITS graduates who want to get a professional bachelor's to attend only one final year at the Polytechnic of Turin.

In addition, the Polytechnic of Turin will co-operate with ITS to give its students access to ITS' technical laboratories. Most ITS are equipped with modern laboratories that are provided by firms co-operating with them, to train individuals able to plug immediately into their production processes. To achieve this result, firms have provided ITS with modern machinery tools that the institutions can use to train students. Thus, by co-operating with ITS, the polytechnic gains access to their facilities.

The Italian experience illustrates the possibility of integrating professional education at ISCED levels 5 and 6. The aim is twofold: i) streamline educational pathways and provide individuals with the possibility to move from one education ladder to another; and ii) generate new professional figures that will help local firms be more innovative and productive.

Italy offers many examples of collaboration between regional governments and universities. Based on evidence collected on study visits, regional policies in regions such as Emilia-Romagna, Sardinia and Tuscany have been successfully supporting HEIs engaging with their ecosystems. For instance, the University of Bologna, in federation with all the other universities in Emilia-Romagna, has established a partnership with the local

automotive industry (the so-called “motor valley” that is home to car producers such as Ferrari, Lamborghini, Maserati, Pagani, etc.) to organise education programmes and internships. In the same vein, but focusing on cultural amenities, the Tuscany region has been promoting the engagement of the University of Siena with rural communities such as Poggibonsi, where the university has created an archaeo-drome (an open-air museum) to support tourism businesses.

Monitoring and evaluation of knowledge exchange

Italy has developed knowledge and good practices concerning the evaluation of the performance of higher education institutions and is currently experimenting with innovative approaches to assess university engagement. The importance of evaluation practices in the country depends on the large share of the public budget allocated to universities based on their research performance, a much larger share than that allocated by evaluation systems in other OECD countries (OECD, 2017). Since 2009, over a total of about EUR 7 billion, approximately EUR 1 billion per year, have been allocated based on research results.

At the centre of the evaluation system is ANVUR, the National Agency for the Evaluation of the Universities and Research Institutes. ANVUR has also started discussion groups to look at monitoring and evaluating university activities related to third mission or “engagement”. In particular, ANVUR has divided third mission activities into two main areas, respectively involving the generation of economic value from research and the production of public and social goods. Concerning the first area – generating value from research – ANVUR has designed quantitative and qualitative indicators measuring intellectual property management (patents and plant variety registrations), academic entrepreneurship (spin-offs), third-party activities and intermediation activities. Regarding the second area – the production of public and social goods – ANVUR uses qualitative indicators measuring the management of cultural activities and the cultural heritage (museums, archaeological excavations and cultural heritage), clinical trials, continuous education and public engagement. Evaluation also involves peer-reviewing activities. Additional information about technology transfer activities and academic spin-offs, patenting and licencing are available via the survey managed by NETVAL.

Despite these advancements, some challenges in defining standard metrics for the evaluation of “engagement” remain. The regulator considers “engagement” as an institutional responsibility to which universities answer according to their own development priorities and research fields. Therefore, “engagement” can be very important in certain university contexts and very marginal in some other contexts. This generates structural diversity in the system, which hampers the comparability of HEIs. This is a common challenge across OECD countries, as illustrated by Box 3.6.

Box 3.6. 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-fits-all sets of indicators that match 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.

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 emphasises a process-oriented measurement moving away from focusing only on quantitative outcome-based indicators (OECD/EU, 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 (OECD/EU, 2018).

In the United Kingdom, 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 (CPD), 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.

In Australia, as part of the government’s National Innovation and Science Agenda, the Engagement and Impact Assessment (EI) was piloted in 2017 (Australian Research Council, 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: i) any assessment must be rigorous; and at the same time ii) 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.

Source: Australian Research Council (2017), *Engagement and Impact Assessment Pilot 2017*, Australian Government, Commonwealth of Australia, ISBN 978-0-9943687-6-8 (online); Coates-Ulrichsen, Tomas. (2014). *Knowledge Exchange Performance and the Impact of HEIF in the English Higher Education Sector*. 10.13140/RG.2.1.1748.4409; OECD (2018), *OECD Regions and Cities at a Glance 2018*, https://doi.org/10.1787/reg_cit_glance-2018-en; OECD/EU (forthcoming), *Supporting Entrepreneurship and Innovation in Higher Education in Croatia*, OECD Skills Studies, OECD Publishing, Paris/EU, OECD, Paris/EU, Brussels OECD/EU (2018), *Supporting Entrepreneurship and Innovation in Higher Education in the Netherlands*, OECD Skills Studies, OECD Publishing, Paris/EU, OECD, Paris/EU, Brussels, <https://doi.org/10.1787/9789264292048-en>; Rossi, F.; Rosli, A. (2014). “Indicators of university–industry knowledge transfer performance and their implications for universities: Evidence from the United Kingdom”. *Studies in Higher Education*. Vol 40. pp 1-22. <https://doi.org/10.1080/03075079.2014.914914>

Strengths in the Italian university system

Italian HEIs have a good awareness of knowledge exchange and collaboration and its implications

Italian universities are aware of the importance of their engagement with society. All case-study universities have engaged in knowledge exchange and collaboration activities in many different ways. University leaders and institutional strategies often promote knowledge exchange and collaboration activities. However, engagement activities have been observed also in institutions whose strategies do not formally mention third mission activities.

As in other OECD countries, the type of knowledge exchange activities developed by HEIs varies considerably depending on the type of university and the surrounding ecosystem. Italy has some specific features that affect collaboration between universities and their ecosystems. First, the country is home to a large and globally connected manufacturing sector (the largest in Europe only after Germany’s). Second, the vast majority of firms are small- and medium-sized, typically family-managed. In some cases, especially in the centre-north of the country, small firms have traditionally clustered creating dense productive communities called “industrial districts” (Becattini, 1987).³ Third, Italy has a complex geography based on a vast number of intermediate cities, requiring advanced social services and expertise. Fourth, there are large regional disparities: some southern regions are lagging behind compared with European averages and receive support from the European Cohesion Fund. Last, the country is home to an immense cultural legacy, which generates opportunities for collaboration with HEIs beyond science and technology.

The next sections will focus on the different form of knowledge exchange and collaboration universities undertake with business and society, including with cultural institutions and assets. The discussion will take into account actions to support academic entrepreneurship of faculty and students (within HEIs) and knowledge exchange activities with external stakeholders.

Support for entrepreneurship and innovation within HEIs

Concerning academic entrepreneurship, most Italian universities have technology transfer offices (TTOs) and about one-third participate in incubators supporting faculty and students trying to commercialise the results of their research. TTOs and incubators assist academic entrepreneurs with the “proof of concept” – with the aim of reducing the mortality of start-ups in the first year of their activity, the so-called “death valley” – and help them attract venture capital and investors. Importantly, there is a good understanding that knowledge exchange and collaboration are not for faculty only or for students only, but for both. MIUR promoted some important innovation to improve the quality of teaching and learning. For instance, universities must involve external stakeholders in the design and monitoring of study programmes and employability rates have been gaining importance when evaluating study programmes. All these efforts aim to embed creativity, entrepreneurship and other 21st century skills in student’s curricula. Universities have increasingly focussed on entrepreneurship education. Study programmes, and expected learning outcomes, have been developed in collaboration with external stakeholders, in order to take into account their actual needs.

Universities have benefitted from new arrangements such as internship programmes and industrial PhD programmes to give students the possibility to engage with businesses. It is now a common occurrence that Italian universities help students take advantage some form of training, including in R&D activities. There are several good examples of student engagement, e.g. in Siena, where a local bank offers internship opportunities to students from the local university.⁴ The contamination labs of Cagliari and Turin operate between their respective HEIs and the local business communities to provide students with an entrepreneurial mindset (Box 3.7).

Box 3.7. Contamination labs in Turin and Cagliari

Contamination Lab in the Polytechnic of Turin

C.lab Torino is a Contamination Lab, in other words, an informal meeting place for students and faculty from different disciplines, organisations and companies to generate new ideas, projects and companies. C.lab Torino was founded by Politecnico di Torino and the University of Torino and is partially funded by the Ministry of Education, University and Research (MIUR). C.lab provides facilities but also events such as hackathons and tailor-made programmes for students and graduates who want to answer challenges submitted by companies and/or faculty.

CREA at the University of Cagliari

This entrepreneurship centre at the University of Cagliari supports an entrepreneurial culture, enhances inter-disciplinary activities and creates innovative business projects through the contamination among diverse areas of studies. CREA is a crucial linkage among entrepreneurs, stakeholders, ideas and opportunities emerging inside the University of Cagliari. The centre builds bridges between students, researchers and entrepreneurs who act locally and globally.

Active engagement in knowledge exchange and collaboration of HEIs with business

Italian universities engage with entrepreneurship and innovation outside academia, with business stakeholders in different forms. Polytechnics are very active in knowledge exchange activities with businesses. For example, the Polytechnic of Turin, in co-operation with a Turin-based bank foundation (*Compagnia di San Paolo*), has developed the LINKS Foundation, an entity that promotes digital innovation for the economy and society. The Polytechnic of Milan co-ordinates a competency centre, in partnership with a large number of firms in its ecosystem. Likewise, the engineering school of the University of Naples Federico II has developed extensive co-operation programmes with businesses in its “academies” (four high-level professional schools that the university has developed in co-operation with Apple, Cisco, Deloitte and Ferrovie dello Stato – Italy’s railway company – respectively) and through the Advanced Centre for Metrological Services CeSMA.⁵

Co-operation with businesses has also become a priority for HEIs undertaking excellent basic research such as the Scuola Superiore Sant’Anna, the Scuola Normale Superiore, the Scuola IMT Alti Studi Lucca and the IUSS Pavia. These small HEIs have joined forces to develop a joint TTO (JoTTO) and organise the JoTTO Fair, in which firms can discover the research activities carried out by students.

Because of the number and importance of SMEs in Italy, many universities have been seeking to engage with smaller firms, including in the south of the country, which is characterised by firms in more traditional sectors.⁶ In 2016, SMEs represent 99.9% of the Italian industry in terms of the number of enterprises, 66.6% in terms of persons employed and 56.8% in terms of added value (European Commission, 2017). Many HEIs have developed a strong relationship with Confindustria to reach out to SMEs and involve them in different types of activities. The involvement of external stakeholders in curriculum design foreseen by the legislation is being implemented by the Universities of Bologna, Cagliari and Palermo through the participation of representatives from local branches of Confindustria. Universities use clusters and research labs as platforms to exchange with SMEs and offer them services or trigger collaboration opportunities. Relevant examples are the NEST Lab in Pisa (National Enterprise for Nano-Science and Nano-technology) and the Fondazione Cluster Marche, founded by the Marche Region’s Technological Clusters.

Finally, HEIs can become an anchoring factor for the development of an industrial cluster in a given ecosystem. A dynamic university, producing excellent research connected with academic entrepreneurship (spin-off companies) and supported by local public authorities and government agencies may attract firms and research activities carried out by the business community. This is the case in Pisa due to the presence of excellence research in bio-robotics at the Sant’ Anna School. Other examples of these dynamics include the Tuscany Life Sciences Cluster and the Digital Innovation Hub 4.0 Sardinia (Box 3.8).

Box 3.8. Clusters as channels of knowledge exchange: Examples from Tuscany and Sardinia**The Tuscany Life Sciences Cluster**

Tuscany has a long tradition of research and development (R&D) in the life sciences. In 2004, regional stakeholders founded the Toscana Life Sciences Foundation to pursue and reinforce this part of the national economy and identity, and to enhance opportunities of commercialisation of life sciences research results. Later, the Tuscany Life Sciences Cluster and the Regional Technological District of the Life Sciences were created in 2011 by the Tuscany region to gather R&D activities in life sciences for regional growth. The cluster groups approximately 190 small, medium-sized and large businesses, the local universities of Florence, Pisa and Siena, the Sant'Anna, Pisa and other public and private research organisations.

The Digital Innovation Hub in 4.0 Sardinia

The Digital Innovation Hub (DIH) 4.0 Sardinia comprises universities in the region, Sardinia Confindustria, National Confindustria, the Union of the Chamber of Commerce and the Autonomous Region of Sardinia. DIH 4.0 Sardinia is part of a national network comprising 19 DIHs, sponsored by the Ministry of Economic Development (MiSE). The government mandate of DIH 4.0 Sardinia is to support the conversion to digital technology in the industry, including the technological transfer, innovation and organisation of businesses to promote the productivity of system processes.

DIH 4.0 Sardinia is responsible for evaluating actors in the digital and technological innovation fields at the national and international levels. It also arranges workshops, conferences, undergraduate courses, prizes and scholarships for students. The hub has these aims:

- To support businesses by identifying needs, opportunities and technological options.
- To plan activities and disseminate information to businesses on the opportunities available in the Industria 4.0 national plan.
- To mentor managers and operators. Through targeted collaboration agreements, to promote a network of public and private actors with skills useful for carrying out the digital transformation of businesses and the transfer of technology.
- To aid access of businesses to regional, national and European funding, both public and private.

Knowledge exchange and collaboration based on social and cultural engagement

Collaboration and knowledge exchange activities are not limited to businesses and many universities have found alternative ways to fulfil their engagement mission. Many HEIs have adopted the Sustainable Development Goals agenda to inform and guide their engagement strategies.⁷ In Rome Tor Vergata, Sustainable Development Goals are actually at the centre of their engagement agenda. In the same vein, the University of Bologna has developed a strategy – Alma2021 – that defines actions under each of the 17 SDGs. At the University of Siena, the Santa Chiara Lab (Box 3.9) organises its various activities in accordance with these goals. Nonetheless, several stakeholders at the workshop in Milan have asked for further integration between science and the humanities, taking advantage of the new enabling technologies.

Many universities also collaborate with subnational authorities, in particular regions and municipalities from which they get funding to create local economic and societal impact, but not only. However, some universities show a will to expand this, by involving the civil society for instance, through cultural events, conferences and lifelong learning. In some southern regions, HEIs have been using EU structural funds to conduct knowledge exchange and collaboration activities with stakeholders. For instance, the new campus of the University of Naples “Federico II” was built using cohesion funds, considering the localisation of university facilities in an impoverished neighbourhood as an action to promote urban regeneration and economic development.

Box 3.9. Engaging through SDGs – The case of the Santa Chiara Lab in Siena

The Santa Chiara Lab of the University of Siena is a multidisciplinary teaching and learning centre where faculty and students can find support to develop collaborative projects. It hosts the Santa Chiara Fab Lab, where everyone – including the general public – can attend courses or use facilities such as 3D printing or laser cutting. The Santa Chiara Fab Lab is a self-sustained organisation within the university, managed by two fixed positions. The lab can be a meeting place for citizens and researchers to develop products, for instance in the development of Quietude, a collection of jewellery through which deaf women can experience sound. The lab exemplifies both the economic and societal aspects of knowledge exchange and collaboration, as well as the synergies between the three missions of a university – teaching, research and valorisation of research. Indeed, the lab has a commercial orientation, since it gets funding from customers; in addition, it is open to all, from inside or outside the university.

To promote collaboration and engagement, some universities have established foundations, often in partnership with local authorities. Foundations are more agile and quick to start up projects and therefore in some cases a more appropriate partner for non-academic stakeholders. For instance, the *Fondazione Politecnico di Milano* (Box 3.10), created in partnership with the public sector (region and municipalities), industry and other organisations, works as a matchmaker between regional needs and research capacity of the Politecnico and as a support in research funding applications.

Box 3.10. The *Fondazione Politecnico di Milano*

The Politecnico di Milano created a foundation in 2003, the *Fondazione Politecnico di Milano*, in collaboration with businesses (such as ENI, Pirelli or Siemens) but also the public sector (municipalities and region), to support both research activities within Polimi and the economic and social development of the region. Polihub, Polimi’s incubator, is managed by the foundation.

The foundation also provides lifelong learning. Beneficiaries of the foundation are not only its founders but also its 200 partners. The main advantages of this status of foundation is to be less constrained by university bureaucracy and thus to be able to act faster, with greater flexibility. The foundation manages approximately 200 projects per year, matching regional needs and university research, and providing support for instance in terms of funding application or network creation.

Because of the importance of cultural amenities in Italy, several universities have developed activities to engage in social sciences and humanities. For instance, the archaeology department of the University of Siena actively works to improve the visibility of historical assets in the region and help communities recognise the value of their historical assets. The department has developed several projects, including another archaeological site, the *Archeodromo di Poggibonsi*, which helped to attract visitors in the small municipality lying out of regional tourist circuits. Other examples concern activities to help local communities forge their historical identity and use it to market agri-food products, including wine. In the same vein, the University of Naples “Federico II” has developed a project – the *Illuminated Dante Project* – that helps a local library capitalise on antique books and other artistic assets.

HEIs are evaluating their knowledge exchange and collaboration activities to increase funding

Another strength of Italian universities is the fact that some case-study HEIs have developed methods to evaluate knowledge exchange and collaboration activities, with the aim of allocating them more funds. These attempts are mostly bottom-up initiatives that are not co-ordinated with the national process put in place by ANVUR, as discussed above. For example, the University of Bologna, where knowledge exchange is a strategic priority, has created a third mission observatory. The observatory has developed an evaluation system of faculty that takes into account their knowledge exchange and collaboration activities, besides their research excellence (see chapter on organisational capacity).

Weaknesses in the Italian HEI system

The Italian higher education system and many individual universities lack a strategic approach to knowledge exchange and collaboration

The lack of strategies to co-ordinate knowledge exchange and collaboration, both at the national and individual HEI levels, represents the main weakness of the Italian system. There is a large number of bottom-up initiatives but the governance fragmentation and lack of horizontal co-ordination reduce the overall impact. Therefore, despite the presence of some national champions – capable of collaborating and being visible in key international networks – the Italian system struggles to take advantage of its status of second manufacturing economy in Europe.

There is a low level of “institutionalisation” of engagement activities, including knowledge exchange and collaboration. The importance of knowledge exchange and collaboration with external stakeholders is well understood by some faculty members, especially in those disciplines where collaborations are essential to develop research and teaching, but it is rarely set as a formal priority in universities’ strategies. This generates some challenges and is certainly not linked to the sustainability of a given approach. The level of engagement of a given university depends on the agenda of the rector and its team, and may change when his/her mandate is over.

These limits in the institutionalisation of engagement activities are also mirrored by a lack of institutionalised relationships between external stakeholders – public entities or private firms – and universities. External stakeholders are represented in the Administrative Board of Universities and there is a compulsory consultation in design and revision of study programme, but these structured relations often do not focus enough on engagement activities or are not sufficiently close-knit to do so. As far as knowledge exchange and

collaboration is concerned, these relationships are usually linked to personal networks, resulting in sporadic contacts and a continuous change of references within the organisations.

Furthermore, in a situation where there are strong budget constraints, choosing knowledge exchange as a strategic priority is not enough. The university needs to have the capacity to provide support to its faculty, staff and students to engage in knowledge exchange and collaboration and in particular to develop long-lasting relationships with external stakeholders. All of these activities require long-term investment and specialised positions within a faculty. Most Italian universities, including those that have developed ambitious institutional strategies for engagement, face structural problems due to the lack of funding.

For knowledge exchange and collaboration to be effective, commitment needs to be bidirectional: external stakeholders should also be open and pro-active towards HEIs. To achieve this result, it is important that all stakeholders in the system harmonise their visions, narratives and strategies. University actions in particular need to be in line with national and regional policies, which are relevant for knowledge exchange. Public authorities should design industrial and innovation policies capitalising on the potential role of HEIs in productive systems, for example.

The policy portfolio should co-ordinate across different ministries and national agencies, in order to optimise funding allocation and avoid inconsistency and fragmentation. There is evidence that Italy does not perform well in its governance systems supporting innovation and skills (OECD, 2017a). There are some international examples that Italy could take into account to improve the overall co-ordination capacity, including in specific industries, such as the automotive sector (Box 3.11).

Box 3.11. Automotive Dynamics & Control Group, Tsinghua University in China

This case describes how academic entrepreneurs commercialised two technologies through their interaction with industry. The Anti-Lock Braking System (ABS) and the Automated Mechanical Transmission (AMT) were the focus of a successful industry-university (I-U) knowledge transfer with the Automotive Dynamics & Control Group at Tsinghua University in China; the transfer exemplifies the academic entrepreneurship (AE) ecosystem at work. The integrative framework we established defines sources of I-U knowledge transfer, the contents of the transfer and the phases of AE, as well as their interacting linkages.

Three sources supply the university with industrial knowledge: previous experiences involved academics, commercialisation partners and leading customers. The content of the knowledge being transferred primarily includes entrepreneurial norms, which emerge from academic experiences in industry; market information, from commercialisation partners; and information on application contexts, from leading customers. The framework also describes the chronology of the I-U knowledge transfer between the source and its corresponding content with the university: during the early stage of invention, academic entrepreneurs lean heavily on their own industrial experience; during the consolidation to practice phase, commercialisation partners supply the learning; and in the last phase, the malfunction exposure and renovation stage, learning flows from leading customers.

The next sections discuss in detail the three major challenges facing knowledge exchange and collaboration in Italy: i) generating incentives and narratives to promote strategic vision and co-ordination; ii) strengthening the role of intermediary institutions to bridge HEIs with their ecosystems; and iii) generating synergies among the three university missions to strengthen knowledge exchange and collaboration.

Generating incentives and narratives to promote co-ordination

HEI strategy for knowledge exchange and collaboration needs to be supported by the right incentives for internal and external stakeholders. In Italy, too often researchers face the dilemma between producing (and publishing) excellent research and engaging with external stakeholders. This situation depends on the national system of evaluation of research, which is still mainly based on research excellence (i.e. the number and quality of publications). Also, the allocation of the state budget depends disproportionately on the evaluation of research results (OECD, 2017). This catalyses the challenge of developing “institutional” engagement activities.

Several stakeholders participating in the Milan workshop stressed the need for: i) clear incentives for the staff involved in technology transfer; ii) dedicated structures, capitalising on ad hoc professional competencies and resources (such as the example of the “broker” discussed above); and iii) a line of funding also for those enterprises that actively support the engagement activity of the university.

As discussed in Chapter 6 of this report, collaborating and exchanging knowledge with society and the economy requires overcoming relevant organisational obstacles and red-tape bureaucracy. First, engagement – by definition – can be sustained if the staff is supported and motivated. Second, entertaining fruitful relationships with businesses requires being able to answer quickly to the operational needs (e.g. in the case of public calls, tenders, etc. for which universities have the same constraints as any other entity within the public administration) and to make information available and easily reachable for external actors (e.g. on ongoing research projects, available competencies, etc.). Without these elements, those firms which are considering collaborations with universities would either be discouraged from new investments or would do it autonomously, either by setting up internal research labs or resorting to other non-university providers.

Within the system, there is also a need for new narratives concerning collaboration, which can affect the behaviour of university researchers. Stakeholders interviewed during field-visits revealed that too many faculty and students carrying on basic research do not consider entrepreneurship and innovation as attractive opportunities. However, the very same students and researchers, asked if they liked to be creative, adopted a far more positive approach. Based on this anecdotal evidence, there may be a need to make it explicit that entrepreneurship encompasses creativity and the adoption of an entrepreneurial mindset and it is not only associated to business creation. This same approach is shared by the Marconi Institute for Creativity, a joint initiative by the University of Bologna and the Marconi Foundation. This institute provides training to develop and democratise creativity, both within universities in Bologna and in the private sector. At the international level, there are many examples of initiatives to promote creativity through teaching. One of these is the Technion-Israel Institute of Technology (Box 3.12).

Box 3.12. Project-based innovation learning from traditional industry at the Technion-Israel Institute for Technology

At the 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.

Rationale

As part of the research done by interviewing 162 chief executive officers (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 weak 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 solving problems.

It is also an opportunity for 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 programme across all of Israel, including the country's most prestigious universities as well as newly established colleges at its periphery.

Accomplishments

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

Source: based on <https://www.technion.ac.il/en/technion-israel-institute-of-technology/> visited on March 2019.

Investing in the relations and strengthening the role of intermediary structures to bridge HEIs with their ecosystems

Italian HEIs also need to improve the systemic capacity of higher education to co-operate with business and society as a whole via intermediary structures such as incubators, accelerators, science parks and TTOs, following an open innovation paradigm. These are structures common in many universities in OECD countries, although the level of success depends on the way they are designed and connected to external stakeholders. They can

depend directly on a given HEI or being co-managed by HEIs in co-operation with regional and local stakeholders. Regardless of the governance arrangement, it is important that these structures facilitate a multi-directional flow of resources. To achieve this objective, it is crucial that TTOs, incubators and other academic facilities promoting collaboration house external stakeholders and behave like a gateway between the universities and the external community.

When thinking of incubators, HEIs and private sector representatives could have the joint use of the facilities and services of incubators. External stakeholders should also be involved in the management of the incubator, including its financial aspects. In some international good practices, incubators are placed outside university campuses to facilitate access from external stakeholders and become community landmarks. There is a need for all these conditions to generate osmosis between HEI incubators and productive ecosystems.

Some HEIs in Italy have attempted to go in this direction and embedded their institutions in their ecosystems. A good example is the incubator “New Steal” at the University of Naples “Federico II”. The incubator is based on the strong collaboration between the university and the regional branch of the industrialist association, Confindustria. The incubator hosts academic entrepreneurs but also start-uppers coming from outside the university, identified by mentors and other professionals working in the facility. Within the incubator environment, there are co-working spaces and activities supporting digitalisation and internationalisation. It should be said, however, that many case-study universities reported difficulties in engaging or co-ordinating with science parks, often located far away from university facilities and campuses.

One of the conclusions the stakeholder workshop underlined is that industrial PhDs should also be used in a more strategic way in this respect. First, this type of doctorate requires an intermediation between firms and doctoral schools, to facilitate the interactions among them. Doctoral programmes should communicate with a language firms can easily understand, and promote existing initiatives. For example, firms often criticise the fact that many PhD programmes mainly focus on academic outputs – such as publications – or that they cannot take part in the selection procedures of the PhD candidates. Second, while firms promote research for high technology readiness levels (TRLs) – say, 7, 8, 9 –, universities typically promote research for the lowest TRLs (1 and 2); industrial doctorates should act as bridges and focus on projects with intermediate TRLs to close the gap.

Some new educational programmes could facilitate osmosis between universities and productive ecosystems. The implementation of *Lauree professionalizzanti* – professional tertiary education programmes that will be put in place in some Italian HEI for the first time in 2018/19 – may represent another gateway for external stakeholders to participate in the design of curricula and in the professional education of students. The Italian higher education system, however, could also capitalise on the presence of *Istituti Tecnici Superiori* – ISCED 5 education institutions. Since 2015, ITS graduates have been enjoying remarkably high employability rates illustrating the need for this kind of professional profile on the market. In this framework, it would be important to enhance co-operation between *Lauree professionalizzanti* and ITS, as in the case of the Polytechnic of Turin (Box 3.13).

Box 3.13. Integrating professional bachelor's programmes with ISCED level 5 institutions (ITS): The experience of the Polytechnic of Turin

The co-operation between the Polytechnic of Turin and the regional government of Piedmont

The Polytechnic of Turin is experimenting the possibility to generate pathways between ISCED level 5 HEIs, called Technical Higher Institutions (*Instituti Tecnici Superiori*), and the professional bachelor's programme (*Laurea professionalizzante*), a new university degree (ISCED level 6) introduced in the 2018/19 academic year.

The Polytechnic of Turin is an important regional actor. It co-operates with other institutional actors such as the regional government of Piedmont and the City of Turin. Taking advantage of its institutional capital, the polytechnic has been co-ordinating a regional round table to discuss the harmonisation of ITS curricula with its new professional bachelor's degree. The round table involves all the regional ITS specialised in manufacturing vocational education and training (VET), regional and local authorities and other stakeholders, such as the regional branch of the national industrialist association, Confindustria.

Regional ITS involved in this policy dialogue should update their curricula to make them modular with the professional bachelor's degree offered by the Polytechnic of Turin. This will allow ITS graduates who want to get a professional bachelor's to attend only one final year at the Polytechnic of Turin.

In addition, the Polytechnic of Turin will co-operate with ITS to give its students access to ITS' technical laboratories. Most ITS are equipped with modern laboratories that are provided by firms co-operating with them, to train individuals able to plug immediately into their production processes. To achieve this result, firms have provided ITS with modern machinery tools that the institutions can use to train students. Thus, by co-operating with ITS, the polytechnic gains access to their facilities.

The Italian experience illustrates the possibility of integrating professional education at ISCED levels 5 and 6. The aim is twofold: i) streamline educational pathways and provide individuals with the possibility to move from one education ladder to another; and ii) generate new professional figures that will help local firms be more innovative and productive.

Promoting synergies among the three university missions to strengthen knowledge exchange and collaboration

Embedding entrepreneurship, creativity and innovative activities in the teaching and learning process is an opportunity to be further developed in the Italian higher education system to support knowledge exchange. There is pressure on universities to become more entrepreneurial, innovative and deliver values for society. The key challenge to achieve this result is to mainstream entrepreneurship and entrepreneurial mindsets across the university organisation and activities, including teaching and research. Entrepreneurial universities need to mobilise all of their faculty members and students to support knowledge exchange and collaboration.

Teaching and learning activities can be improved by supporting academics in innovating their methodologies, by involving more significantly external stakeholders in programme design and by empowering students in their learning process. There are many different

ways to achieve this result such as providing open spaces and facilities for collaboration with external actors. HEIs can also involve representatives from business and society in lectures (Box 3.14), joint workshops, and networking events and opportunities (e.g. the “entrepreneurship breakfast series”). An important part of the external collaboration is mobility of staff and students through internships, sabbaticals and dedicated study programmes (e.g. industrial doctorates, sandwich programmes).

The entrepreneurial mindset of students is also developed by their direct involvement in knowledge exchange activities, even if institutional strategies too often overlook them. In many OECD countries, while students are to a large extent involved in university start-ups, entrepreneurship support activities and business contacts in general, their participation in such activities could be more strategic and more forward-looking (Klofsten and Lundmark, 2016). Nurturing students’ mindsets with entrepreneurship is also important to respond to the needs of external stakeholders, whose rationale to get involved in science parks and incubators is to access and recruit talents and young pre-professionals, among university undergraduates (Cadorin, Johansson and Klofsten, 2017; Bellavista and Sanz, 2009). In addition, long-term strategies promoting students’ entrepreneurial mindsets, implemented in co-ordination with stakeholders and public authorities, can be a way to promote regional economies.

Box 3.14. The involvement of professionals in teaching: Temporary teaching assistant contracts in France

In France, universities and other types of higher education institutions have the possibility of temporarily hiring professionals, whether CEOs or employees at a public or private organisation, to teach in courses related to their professional activity. This type of position is called “*chargé d’enseignement vacataire*”, i.e. temporary teaching assistant. It is mostly used in vocational programmes, such as engineering schools or business schools. This could be for instance an accountant teaching accountancy, a lawyer teaching business law or a company manager teaching business strategy, etc. In addition to bringing insights and tips from the field to the students, having a professional as a teacher can potentially result in internship or recruitment opportunities for students.

Note: For more information, see this SciencePo Toulouse webpage (in French): <http://www.sciencespo-toulouse.fr/recrutement-de-vacataires-d-enseignement-505428.kjsp>.

HEIs, however, can find it challenging to design knowledge exchange and collaboration activities for the whole of the student community, in all university faculties and departments. This depends on the student numbers compared with existing opportunities and organisational costs, and on the heterogeneity of students’ expectations in terms of collaboration with external stakeholders. For example, students attending teacher colleges may aim to collaborate with the public sector (schools and other education institutions). Conversely, students at technical faculties may look for a collaboration with businesses and, in particular, knowledge-intensive firms. Integrating research, teaching and knowledge exchange and collaboration activities can stimulate the creation of new knowledge and provide students with innovative learning opportunities.

Achieving these results, however, is not easy. HEIs have to create mechanisms to integrate and absorb information and experience from the wider ecosystem into their teaching and research activities. In addition to creating spaces for dialogue with external stakeholders,

they have to monitor research activities undertaken outside academia to identify new and relevant knowledge.

The capacity to generate synergies among academic missions characterises some of the Italian case-study universities. For instance, the incubator of the University of Cagliari represents a good practice for its capacity to co-ordinate incubation activities with teaching and research projects and to capitalise on collective intelligence and diversified knowledge (Loi et al., 2017). Students, as a part of their education, can work in smaller firms to learn to practise and implement what they have learnt. Representatives from local firms are also invited as guest lecturers. At the University of Bologna and at the Sant’Anna Institute, students are encouraged to gain work experience in non-governmental organisations (NGOs), often abroad, during the study programmes to learn how to work in different environments.

Box 3.15. The Danish cluster initiative Biopeople

Biopeople was founded in 2005 and is a Danish life science cluster base at the University of Copenhagen. The initiative is a part of the country’s efforts to support innovation and is co-funded by the Ministry of Higher Education and Science.

Biopeople enhances the collaboration between firms and public research and aims to pursue changes within the healthcare sector and increased attention given to future biomarkers, diagnostics, personalised medicine and stakeholder involvement as well as patient and investor communities, for example. Through different programmes and networking activities, the mission is for firms and entrepreneurs to become a part of the worldwide business value chain and also to establish public-private and cross-disciplinary partnerships.

Contact: pep@biopeople.ku.dk.

Source: <https://www.clustercollaboration.eu/cluster-organisations/biopeople-denmarks-life-science-cluster>, visited on June 2019.

Conclusions and recommendations

The potential of Italian HEI system in terms of knowledge exchange and collaboration is strong but largely underutilised. The Italian system is characterised by many good practices at the HEI level, yet the lack of strategies, long-term commitment and co-ordination platforms negatively affects the systemic impact of entrepreneurial universities.

Italian universities have the capacity to win the engagement challenge and to do so should capitalise on the distinctive traits of the national system. First, the continuous and non-episodic engagement with firms and also with public authorities should not transform universities into “service providers”; Italian HEIs possess the DNA of research-oriented institutions and should take advantage of this nature in the interaction with stakeholders. Second, the Italian way is not that of pushing towards a centralised unitary model; it rather tends towards creating an integrated system, a distributed network of territorial nodes and poles. These two characteristics also imply that the university system should abandon the “fractal” model in which all institutions – as with other public administrations – replicate similar activities and organisational structures; they should instead embrace a model of

specialisation, in which each HEI can benefit from its own context, experience, dimension and competencies.

Doing so requires not only overcoming the regulatory limits imposed on the institutions but also ensuring the appropriate funding. The Italian higher education system is underfunded, compared to peer OECD countries, and the situation got worse due to the austerity measures following the global economic recession (OECD, 2017a). The scarcity of funding, exacerbated by the fragmentation of initiatives, particularly affects the capacity to develop third mission activities, which are often considered as residual compared with teaching and research. Increased investment in all missions, including engagement, could generate synergies and more efficient and effective use of resources.

There is a need for new narratives to explain the benefits that HEIs can provide through engagement. The higher education system struggles to be actively involved into policies aiming at innovation, economic development and social inclusion. Industry 4.0 policy demonstrated the potential of higher education in terms of innovation and capacity to interact with business and society. In the same vein, some universities in the south of the country have been able to maximise the availability of EU cohesion funds and use of additional funding to improve their capacity to engage with local communities. Based on these experiences, public authorities should consider HEIs as important partners to design and deliver policies.

Nevertheless, there are remarkable good practices, which would deserve more visibility and national support. For instance, ANVUR, the national agency for the evaluation of higher education institutions has been developing a comprehensive methodology to assess third mission activities, including collaboration and knowledge exchange. Public authorities could support this initiative and pilot some innovative assessments.

At the HEI level, there are many well-functioning and encouraging initiatives in the Italian system aimed to create collaborations (including international collaborations) between academia and society. These initiatives reflect the respective regional contexts, challenges and needs of the local stakeholders. Universities have found different ways of dealing with external stakeholder collaboration and it seems to be that there is no best way of organising third mission activities. However, overall, there is a need for institutional support, because initiatives are mainly bottom-up and very dependent on entrepreneurial individuals, who can encounter bureaucratic stickiness. In this respect, during the stakeholder workshop, it was suggested to create a co-ordinating committee (*cabina di regia*) composed by representatives of different ministries to create and support structured and transversal actions for engagement.

Italian HEIs could play the role of intermediate institutions in their respective ecosystems driving regional development (OECD, 2007; Arrighetti and Seravalli, 1999). The competitiveness of many SME clusters in Italy – which represent the legacy of “industrial districts” – may also depend on the capacity of public policies to generate new institutions. In particular, HEIs could support the competitiveness of SME clusters generating positive externalities including knowledge spillovers, access to international networks and skills.

Recommendations

Based on the analysis above, this chapter identifies several recommendations to the higher education system and individual institutions. These recommendations are listed and discussed below:

1. Incentivising universities to include knowledge exchange and collaboration in their long-term vision, for teaching and for research activities. These incentives may require the integration among policies implemented by different relevant ministries, such as MIUR, MISE, MAE, etc. Non-academic stakeholders, including business, regional and local governments, research entities, NGOs, etc. should contribute to the definition of this long-term vision concerning the role of higher education (institutions) for entrepreneurship in Italy. External contributions can strengthen the vision and make it more resilient vis-à-vis changes in national politics. The interaction with external stakeholders is also important to clarify what HEIs can deliver to their ecosystems and communities and what, conversely, is out of their scope or mandate.⁸ In addition, more effective involvement of internal stakeholders would help, in this respect, to improve institutional cohesion and increase the ownership of the vision in the university as a whole.
2. Institutionalising “engagement” in the governance of HEIs. There is a gap between the decision-making process at the institutional level and the one in departments or in decentralised services. In many cases, the universities are led by very enthusiastic and committed rectors who promote the orientation towards the entrepreneurial university. As already seen, there is also a number of bottom-up initiatives, either led by certain more reactive disciplines or by dedicated structures within the administration. In between, there is often a lack of alignment, that can make it difficult to implement an efficient organisation for the third mission throughout the whole university and to integrate an entrepreneurial mindset in the university culture.
3. Promoting the already well-developed efforts around the monitor and evaluation of knowledge exchange, led by ANVUR. Engage in peer learning and discussion by involving international experts to promote pilot evaluations and experiments featuring the leading best practices at the international level.
4. Supporting the use of cluster initiatives to organise knowledge exchange and collaboration activities between HEIs and ecosystem businesses. So far, university engagement is linked to the initiatives of individuals – including rectors, and entrepreneurship professors. Promoting institutional engagement – rather than “individual” engagement – is likely to make third mission activities more impactful and visible. A strategic approach to knowledge exchange and collaboration with their ecosystems may help universities handle the extreme fragmentation of the productive sector and supply chains, which are mostly based on SMEs.
5. Creating narratives around knowledge exchange and collaboration activities as something enriching for faculty members and students within the university. This could be done by expanding collaborations to involve a broader group of stakeholders, thus enhancing opportunities to find the most relevant stakeholders for each academic activity.
6. Strengthening the student-centred system. Involving students, at all levels, in collaboration with external stakeholders. The Italian economy is thirsty for skills (OECD 2017a, 2017b). Universities need to mobilise all their potential to give students at all levels, including ITS, *Lauree professionalizzanti*, bachelor’s, master’s programmes and PhDs, disciplinary and transversal skills that can help them be active citizens, perform on the labour market and promote the competitiveness of the Italian economy as a whole.

Notes

¹ The funds that were merged were the *Fondo per le Agevolazioni alla Ricerca* (FAR); the *Fondo per gli Investimenti della Ricerca di Base* (FIRB); and *Progetti di Ricerca di Interesse Nazionale* (PRIN).

² Representatives from the productive sector, along with representatives from Italian HEIs, participated in a stakeholder workshop held in the University of Milan “Bicocca” in May 2019.

³ Industrial districts consist in a system of companies, mainly SMEs, characterised by horizontal and vertical integration and productive specialisation, generally concentrated in a specific territory and linked by a common historical, social, cultural and economic experience (OECD, 2017).

⁴ In Siena for instance, the Monte dei Paschi bank alone hired in 2018 16 apprentices and 52 interns; and the only recruitments that were made since 2015 are apprentices at the end of their studies.

⁵ Other interesting examples in the Lombardy ecosystem include: the collaboration between all the universities of Milan and Assolombarda, the local branch of Confindustria; the CORIMAV Consortium for research on materials, created in 2001 by the University of Milan “Bicocca” and Pirelli, funding PhD positions in materials science; the collaboration between Politecnico di Milano and ROLD (innovative firm focused on the introduction of digital technologies in manufacturing processes), where the firm finances inter-departmental research projects and takes advantage of the role of a “broker”, a researcher employed by the company to act as a liaison between the firm and external research centres, including universities.

⁶ One of the contributions of the stakeholder workshop underlined that universities should engage more actively with small and micro firms, which constitute the economic fabric of the country, especially in areas that cannot benefit from dynamic urban agglomerations. So far, this has been one of the limits of competency centres, which privilege the interactions with large firms.

⁷ In this respect, the stakeholder workshop represented an opportunity to identify positive experiences such as that of InVentoLab (<http://www.inventolab.com/>), a B-Corp that promoted entrepreneurial education activities in the social and environmental sectors.

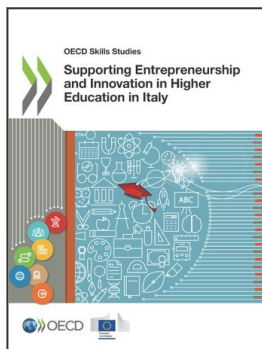
⁸ As discussed at the stakeholder workshop, Italian research universities should not become central of services for the productive sector. However, it would be important that universities are part of an integrated higher education system that capitalises on the presence of new entities (ITS and professional bachelor’s programmes) to connect research with business and society.

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