



European
Commission

Measuring the contribution of higher education to innovation capacity in the EU

Executive summary

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Study on measuring the contribution of higher education to innovation capacity in the EU

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Executive Summary

Context of the study

The current study is part of the actions taken aiming to analyse the links between the operations and **effects of higher-education institutions on the capacity to innovate in the economies in Europe**. Providing insights into the contribution of higher education to the innovative capacity of the EU economies is crucial for policy making and the direction of policy measures in a fast-changing market environment. Universities contribute to societal development and innovation through their three core missions. Firstly, teaching aims to create human capital in the form of more highly skilled labour, more endowed with competences to boost innovation activities. Secondly, research produces knowledge capital that is transferred into innovating businesses, although it is usually embodied in individuals and thus, it is not easily codified and transferred. Finally, the third mission of higher institutions involves knowledge exchange between universities and society in various ways, including consulting and technical services, providing policy advice or contributing to territorial economic development strategies.

The traditional and underlying models for the analysis of the contribution of higher education on innovation capabilities have mainly followed the R&D perspective focusing on the second mission of Higher Education Institutes (HEIs). In this context, indicators measuring this contribution focus on the ownership of intellectual outputs by HEI staff members, providing a framework that relates higher education to innovation outputs. Although this approach includes more than only research and development activities, it seems to “tell only part of the story”. Innovation and the capacity to innovate are also determined by factors such as the supply of human capital, skills, entrepreneurship, intrapreneurship and others. These factors have been increasingly taken into account in policy-driven data collection exercises, although we still lack a complete stock-taking exercise that includes all relevant factors that *adequately measure the contribution of higher education to innovation capabilities*.

There has been a massive expansion of higher education across European countries in recent decades as they attempt to provide their workforces with the skills necessary to successfully compete in the knowledge based economy (KBE). Economic strength in the KBE is being driven by innovation, taking existing resources and assets and using them to do new things better, and increasing overall welfare levels. Whilst the pursuit of innovation is essential for all economic agents, universities are at the heart of policy attempts to increase the overall knowledge capital for innovation, as well as a proving ground for future innovators.

Recently however, there have been concerns that universities are failing to adequately respond to these new demands and are continuing to act as ‘ivory towers’ outside of society, rather than driving society forward (Galan-Muros, 2016). There is, in particular, a perception that universities have tended to expand their existing activities rather than create new courses, pedagogies and learning environments that best meet society’s needs. Where universities contribute effectively to innovation, they can create whole new industries and sectors, and transform the fortunes of particular places. But at the moment, these conflicting narratives make it hard for policy-makers to determine whether and how universities (and indeed, which kinds of universities) can leverage innovation capacities.

A key challenge for European policy-makers is therefore to determine the extent to which universities are realising their innovation potential to meet the needs of the KBE. **In this study, we seek to understand the extent to which universities are supporting innovation**¹.

Objectives of the study

The goal of the study has been the provision of evidence on the key factors determining the contribution of higher education institutions (HEIs) to innovation capabilities and to expand the understanding of this contribution beyond traditional measures of the role of HEI on innovation capabilities. In this context, the general objective of the study can be verbalised as being: **“to develop a more comprehensive model of the contribution of higher education to innovation capacity”**.

More specifically, the objective of the project has been to **develop an indicator set that is capable of providing some degree of measurement of the contribution of universities in Europe to innovation capacity**.

In doing so the study has aimed to develop a prototype set of indicators that will capture the effects of higher education on innovation capacity.

Introduction to the literature review: the HEI activities contributing to innovation capacity

The theoretical analysis producing the study’s literature review starts off with the development of a formal conceptualisation of the process by which **universities specifically** contribute to external resources for innovation in ways that improve innovation activities. Universities undertake particular activities that spill over from their main missions into this knowledge pool, thereby offering potential future innovation resources (this includes cases where universities work in practice with innovators directly to make those knowledge resources directly available). Knowledge is created in core university activities, but at the same time some of that knowledge transforms *in various ways* that allow it to have a non-academic value (that is, a specific value to users).

Universities’ ‘contribution to innovation capacity’ comes through providing resources that innovators need as they attempt to deliver change processes. From that, we define the measurement challenge as fairly quantifying the resources that facilitate innovation. We ideally would measure ‘spillovers’, but that is not empirically possible: spillovers are a conceptualisation we use to understand a regularity rather than something ‘out there’ that can be measured. Spillovers are also a conceptual “residual”, i.e. something that is defined as that which cannot be measured (Breschi & Lissoni, 2001). We therefore focus on measuring those outputs which, in association to other additional resources, can help innovators to expand their innovation frontier.

Having made explicit this abstraction, we identify the kinds of university-derived outputs that feed into activities which ultimately expand innovators’ access to innovation resources. Measurement therefore requires defining variables – the output conceptually connected to

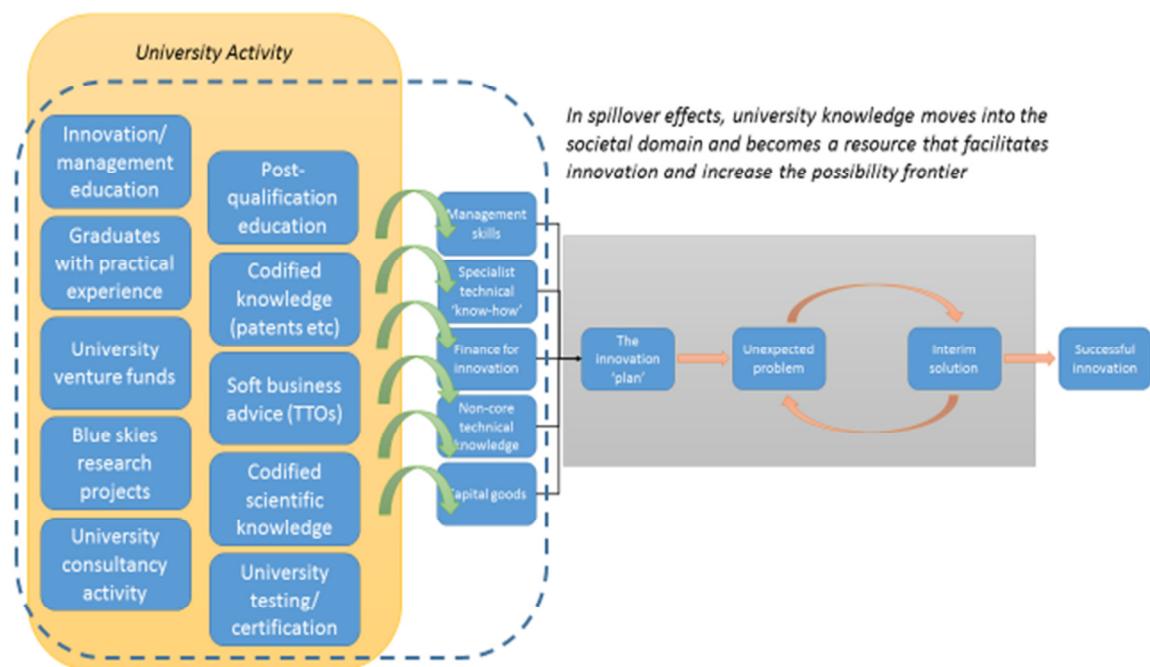
¹ We define ‘innovation’ as the result of a set of activities by which different kinds of knowledge are combined to create solutions and interventions to solve problems, ultimately making society a better place (a form of Schumpeterian perspective). Those societal improvements may be through:

- (a) raising competitiveness and creating new markets and sectors,
- (b) improving the delivery of public services, particularly to vulnerable social groups, or
- (c) reducing our environmental impact.

the innovators' resource frontiers. We therefore seek to identify data that can be gathered and which measure in some way those contributions. Some of these variables will be relatively easy to gather data for, whilst for others they may be largely absent: if there are substantial gaps in coverage, then there would be a case for investing substantial efforts into designing new measures and collecting them in order to be able to better measure this university contribution to innovation capacity.

This in turn helps us to better specify the overarching research problem, namely the fact that there are many measures available that capture direct transactions, whilst relatively few cover the indirect contributions by via the knowledge pool. Whilst knowledge transfer indicators may be a good way to understand the contribution to individual ongoing innovation activities, what they do not provide is a good measure of the 'knowledge pool' from which later activities emerge.

University activity creating externalities that spillover into a knowledge pool (shown by dashed line) facilitating innovator resource access



Key principles leading to the proposed prototype set of indicators: Knowledge transfer and human capital spillovers

Next to what has been briefly analysed in the previous paragraphs, another goal of the literature review has been to identify appropriate empirical dimensions for each of those assets in order to inform the elaboration of appropriate indicators. The analysis has shown that spillovers can be conceptually divided into two sorts:

First, there are those that occur when a piece of knowledge is transferred from within the university into a societal context (e.g. firm, local authority) where it can be used to fill an innovation resource shortage (**knowledge transfer**). Here we distinguish between three varieties of knowledge transfer-related spillovers:

- (a) where there is an activity in which the knowledge is specifically transferred through a transaction with a user in which the knowledge is translated (e.g. licensing a patent)

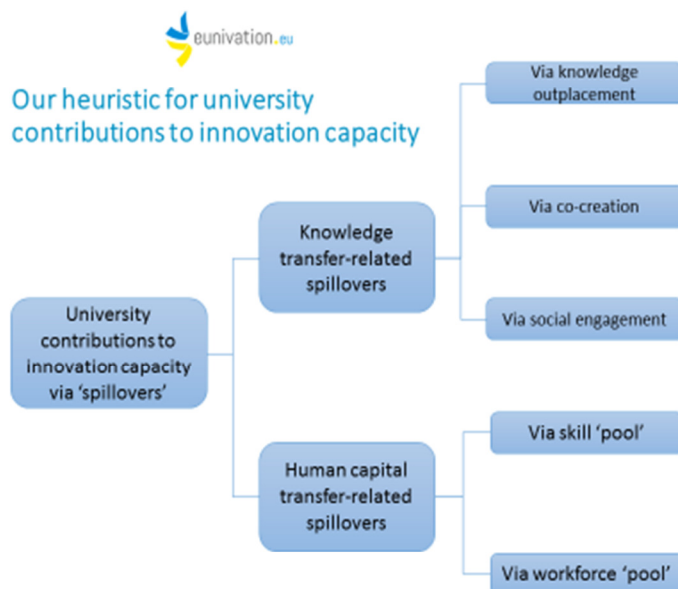
- (b) those that occur when the university and innovator co-create knowledge and the innovator uses a share of that co-created knowledge as an innovation input (e.g. a shared research project), and
- (c) those that occur when university knowledge strikes a chord with a non-innovator, and that serves as the antecedent to possible innovation activities (such as media reports of academic activity).

The second class of spillovers are those that happen when students move into the labour market and make use of the knowledge acquired within the university (**human capital**). They embody knowledge capital that is used as a resource that facilitates new innovations, whether in the economic, public or societal sectors. We further distinguish two ways by which universities contribute in this regard, namely

- (a) the direct education of individuals who then add to the total stock of human capital as they move into the labour force, and their education becomes an innovation-frontier extending resource, and
- (b) the other labour market effects that universities may have by enriching the overall human capital in a place that provides innovation-frontier extending effects, such as in attracting highly skilled graduates, post-qualification education and institutions that improve labour market ‘matching’.

These two classes of spillovers and the subdivisions are shown in the schematic below and form the basis for the measurement approach that has been applied.

Overview of the main structure of the literature review



There is a clear geography to individual university contributions. Some universities will create most spillovers at a very local level, when for example they deliver highly-skilled students specifically attuned to particular locally-rooted sectors. Other universities may make their contributions at national or European levels, for example those that are active in providing Ph.D. training and Horizon 2020 research leadership within wider consortia. Spillovers are an emergent property and are not contained by particular territorial boundaries – universities in border regions will create opportunities for benefit across national and EU borders. In the context of this study, we have primarily been concerned with **contributions to European knowledge pools, and contribution to European innovation**

capacity, although that might be at a pan-EU level, within member-states, within macro-regions or even within localities, cities and rural areas.

Prototype set of indicators: validation phase

During the phase that developed the prototype set of indicators, the challenge lay in the operationalisation, in ensuring that the choice of proxies is such that they maximise the indicators' technical validity and political legitimacy. The study has considered that the indicators are conceptually 'good' and legitimate and address current critiques, as in the following:

- (a) they must be proxies that are measuring something in which a rise can conceptually be considered to be associated with 'increased spill-over benefits',
- (b) they must suggest that there is a university stock that flows and creates an impact, namely they are a university output, suggestive of real world activity, and in which innovators are signalling their interest, and
- (c) they must be improvements on the current state-of-the-art, capturing university mechanisms and behaviours for knowledge exchange, and a broad scope of human capital contributions to innovation capacity.

On that basis, the study proposed a selection of the variables (see sections 2.2 and 2.3) in order to present a first indicator selection for measuring university contribution to innovative capacity. In this, we have firstly sought to ensure that the indicators represent a fair balance of measures by ensuring that they cover a broad spectrum of the dimensions identified in the literature review. There are 19 possible facets by which we can measure elements of university contribution, set out in the final indicator set that follows. These indicators have been the subject of discussion and validation (including feedback for improvement) in a series of interviews with HEI representatives, policy makers and industry representatives across Europe aiming at capturing their personal opinion on the prototype set of indicators. This process, together with a feasibility analysis, resulted in the final proposition of the study about the prototype set of indicators.

Prototype set of indicators: the proposition

The indicators that have been developed are intended to present a balanced score card of university contributions to innovation capacity. It is important to state that we here make a difference between the university as the unit of reporting (data gathering) and what will be chosen as the unit of presentation. We have chosen universities as the unit of reporting because the spillovers originate from university activities, and universities are most strongly positioned to report on that data. But we are clear that we see the unit of presentation as being a territorial one, aggregating data from a number of universities to demonstrate where universities are contributing more or less strongly. Our justification for this is that spillovers depend as much upon take-up as outflow, and in weak regional environments, active, successful universities may make a lesser (or less visible) contribution through no fault of their own. We draw an analogy here with the Community Innovation Survey which presents its results regionally and nationally, and not at the level of individual companies. We envisage that a putative University Innovation Contribution scoreboard would report at a territorial scale, sufficiently aggregated to prevent the distinction of individual institutions.

The final prototype indicator set is presented in the table below. This indicator set was arrived at through a multi-stage optimisation process which sought to choose the best indicators on the basis of a synoptic analysis of their characteristics, the results of the expert feedback consultations, as well as the results of the Field Studies and the questionnaires.

We note in making this optimisation that there is one of the dimensions that is inadequately covered, but for which there were as yet no appropriate indicators: that is the contribution of universities to innovation capacity through the work their academics take on through public engagement, informal interactions with societal partners and other forms of informal outreach. More detail is provided on the optimization process in Chapter 6 and 7 of the current document.

Final indicator set²

Category	University activity	Indicators
Human capital	Lifelong learning	Percentage of academics teaching in courses required by non-academic agents (firms, public sector, NGOs,...)
Human capital	Mobility	Percentage of PhDs undertaken jointly with a private (non-academic) partner
Human capital	Curricula	Participation of non-academic agents in the definition of curriculum development (level measure)
Knowledge transfer	Collaborative R&D	University research funded by industry and by charities/foundations (number of projects, total value and percentage of total)
Knowledge transfer	Consultancy	Income, total value, number of contracts (by: SME, large firms, commercial, non-commercial)
Human capital	Teaching & Learning	Number of students enrolled in entrepreneurship courses as a percentage of all students/ percentage of ECTS)
Knowledge transfer	Infrastructure for commercialisation	Services provided within the commercialisation infrastructure; Seed corn investment (Y/N); Venture capital (Y/N); Business advice (provided by the infrastructure) (Y/N)
Knowledge transfer	Education outreach	HEI budget allocated to educational outreach activities (e.g. school and public talks, career events)
Human capital	Internationalization	Number of ECTS awarded to international exchange students (ERASMUS student) as a percentage of total ECTS
Knowledge transfer	Student start up activity	Student start-ups (total active start-ups, turnover, private funding raised)

This final indicator set has been the result of an optimization process involving various procedures. The aim has been to retrieve an indicator set that is the most legitimate, most technically suitable, most limited in number and has a large extent of university activity coverage. These various elements have been brought together to propose a final indicator set optimised in terms of the following considerations:

- Provision of the broadest possible coverage of the full range of dimensions of UCIC
- Inclusion of indicators that are technically the most suitable for measuring these dimensions and are regarded by policymakers as having sufficient legitimacy
- Inclusion of indicators that have a degree of external validity (expert validity and arguments put forward by stakeholders)

The first step in the optimisation process was to eliminate the indicators that have been weak in one of the three dimensions against which they have been evaluated: (1) being closely associated with a process that results in 'UCIC', (2) being intrinsically good and (3)

² The shading separates out the three indicator coverage spans corresponding to the core (5), optimal (3), extensive (2) coverages

being positively evaluated by the stakeholders. On the basis of these evaluation criteria, we deleted 9 indicators from the indicator set.

The indicators analysed best were included in the core indicator set. The first consideration in choosing a **core indicator set** has been to balance the important university activities that contribute to innovation capacity. The most important activities to cover have been the human capital contribution via skills and knowledge, and the knowledge transfer contribution via collaborative research activities with external users. Three human capital indicators have been selected, with one of them (mobility) reflecting both human capital and knowledge transfer. The other two indicators facilitate the uptake of skills by non-academic agents and the involvement of these agents in defining the curriculum. The two knowledge transfer indicators selected on collaborative R&D and consultancy are activities that demonstrate the interest of an external actor in the knowledge that emerges from universities. In addition, the indicators received the strong support of the stakeholders and experts.

The first consideration in choosing the indicators for the **additional indicator set** has been to sustain the balance between the university activities and to include the activities missing in the core set. As regards the human capital indicators, student throughput was missing and therefore the indicator covering teaching and learning has been included. Concerning the knowledge transfer activities, public engagement and commercialisation had not been covered and these two activities received most support during the optimisation process. The infrastructure for commercialisation provides an indicator of clear commitment to transfer knowledge and the education outreach activity demonstrates the commitment of universities to make research publicly available.

The consideration of the **extensive indicator set** has been to determine whether some dimensions have not been sufficiently covered and whether there are indicators that can provide added information, proportional to the overall further effort to retrieve the data. The internationalization activity has been included because it provides an additional activity of how skills can be activated and used within society. The information for this indicator is already available and/or easy to collect. The indicator for student start-up activity demonstrates the extent to which universities are creating raw materials that can be used for innovation and the extent to which they support the use of this raw material for generating new businesses. This university activity shows an informal innovation contribution and therefore covers an element not yet taken into account. Moreover, the information for this indicator is easy to collect.

Prototype set of indicators: the proposition of the indicators

In the present prototyping study, we have found that there is a **strong degree of coherence around university contributions to innovation capacity by considering the different kinds of spillover effects emerging from universities**. Our model has identified a number of dimensions by which universities generate resources that improve others' opportunities for innovation. These correspond with a wide range of university activities, and were broadly supported by the fieldwork. The prototype itself is not coherent or ready to immediately proceed unaltered towards the development of a Europe-wide scoreboard or indicator set. This is a function of the availability of the data to provide information on the indicators we have proposed.

The indicators that we have proposed emerged from the literature review, and have been used in some particular context by a particular policymaker or researcher to address a single process or mechanism that corresponded in some way with the dimensions we identified in

the literature. But that does not necessarily mean that those measures are the only way of gathering useful data on that indicator. Unavoidably, the fieldwork gathered data on the basis of indicators that emerged from the literature review, partly as a means of trying to get respondents to have an understanding of the conceptual dimensions with which we are concerned. Any possible effects of this methodology should be considered when taking the prototype indicator set along the next step towards a European 'UCIC Scoreboard' or Survey.

Nevertheless, this study shows the support among a broad range of experts for the kinds of indicators that are used in the prototype indicator set. A balanced approach is required to measuring UCIC that does not assume that these contributions are exclusively generated via research activities, but also reflects the various other pathways by which university knowledge activities stimulate innovation.

Our overall recommendation is that the Commission proceeds to develop a **pilot scoreboard for UCIC using the conceptual framework** proposed above, and drawing inspiration from the prototype indicator set as well as the potential alternative indicators.

We specifically recommend that this be driven by a group of **lead users who have a strong intrinsic commitment to developing the indicators**, encompassing the Commission, a set of HEIs and an expert group.

The pilot can build on the more comprehensive understanding of UCIC that has emerged from this study, which should be disseminated to university representative groups, national higher education and research policymakers, as well as European-level institutions and stakeholders. The report presents more detailed recommendations for these categories.

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