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A Regional Innovation Impact Assessment Framework for universities

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A Regional Innovation Impact Assessment Framework for universities

This report provides a framework to assess the impact of universities on their regional innovation ecosystem. The policy context for this work is provided by: a) the Renewed EU agenda for higher education which argued that universities do not attain their full potential; and b) the report by the High Level Group chaired by Pascal Lamy which called for an additional funding stream to support universities to modernise and increase their innovation impact. This report explores what the assessment framework underpinning such an innovation performance based funding instrument could look like. However, it acknowledges that the final form of such a framework would heavily depend on the regional, national or EU level instrument through which it is implemented. The report proposes a system in which universities draft a case study supported by indicators, through which they present evidence of their contribution to regional innovation. It identifies four impact categories and identifies a list of associated indicators. In this "narrative with numbers the universities can both explain how they reach this impact and contextualise their performance with reference to the development level of their region.

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Executive summary

In July 2017, an independent high level group of experts chaired by Pascal Lamy to advise on how to maximise the impact of the EU's investment into research and innovation, called for the introduction of an EU-level performance-based funding of universities. This is to be done on the basis of their 'innovation performance' to promote university modernisation and enhance the positive effect these organisations can have on their regional innovation systems. The reflection on how to design funding systems that encourage higher education to deliver what society needs is also an important element of the Renewed Agenda for the Modernisation of Higher Education (COM, 2017)

This report outlines what such a targeted funding approach could look like, indicating potential design avenues while highlighting the policy considerations that need to be addressed to arrive to an optimal assessment system. The final form and implementation of an assessment system on which institutional funding decisions can be based, will depend on the financial instrument to which it is linked. Since there is no clarity at this stage regarding the financial instrument of choice, the objective of this paper is solely to provide a first input to this discussion.

The target audience of this report are policy makers - at the EU, national and regional level - who are considering the implementation of innovation performance-based funding. This document could also be a source of inspiration for the leadership of universities which can use it as a guideline in assessments of their own innovation performance and their impact on the local or regional innovation system.

This report builds on: (a) the manifold national performance-based funding systems; (b) studies into the development of innovation impact assessment systems requested by national and EU policy makers over the past decade and; (c) the broader economic literature on research assessment and the economic impact of universities.

Those impacts of universities on innovation and regional development are heterogeneous and difficult to assess, especially within a short time horizon given that impacts can take a long period to become visible. Therefore the approach proposed in this paper focuses on intermediate outputs and interactions in addition to direct impacts.

On the basis of a review of the strengths and weaknesses of different assessment approaches, a *Regional³ Innovation Impact Assessment* (RI²A) system is proposed which will enable universities or regional governments to choose indicators to track university progress over time in the context of regional development levels and trajectories. The assessment and indicators should cover at least the following four categories:

- Education and human capital development;
- Research, technological development, knowledge transfer and commercialisation;
- Entrepreneurship and support to enterprise development;
- Regional orientation, strategic development and knowledge infrastructure.

This 'RI²A profile' should feed into a university level case study, a so-called "narrative with numbers", in which indicators of the innovation performance of universities are contextualised and supported qualitatively. This evidence base could be supplemented with information on recently observed impacts or descriptions of specific impact

³ Whereas the initial focus on this report is on the design and development of a Regional Innovation Impact Assessment system, the proposed approach could also be used at other geographical levels.

pathways. University can also describe "how" they have a positive impact on their regional innovation ecosystem, potentially beyond what is captured by the available performance indicators. The contextual information on the region in which the university operates can be supported with indicators on the regional development level.

An important implementation challenge is to find sufficient numbers of skilled evaluators to assess the university-level case studies. Therefore, evaluation panels should include international experts. To this end an EU level pool of experts should be considered. The further development of a RI²A system will require the buy-in and involvement of key stakeholders. In order to be successful the funding provided through the financial instrument, which is informed by this RI²A system, should be supplementary to research and education funding, i.e. there should be no trade-off between research funding and innovation funding. The *Innovation Performance Based Funding* (IPBF) framework proposed in this report also does not aim to replace potentially pre-existing research performance based funding systems in the Member States. Instead it seeks to be complementary to these funding mechanisms.

The next step in the development of such an IPBF framework and associated assessment system can be the preparation of a series of university level case studies to determine the feasibility of this approach across different types of universities in Europe.

1 Introduction

One of the assumptions underlying most regional innovation policies in Europe is that local universities make very valuable direct and indirect contributions to economic activity (European Commission, 2011, p. 10-11). However, in the renewed agenda for European higher education, the Commission identified an innovation gap between universities and their regional economy (European Commission, 2017, p. 4):

"Higher education institutions are often not contributing as much as they should to innovation in the wider economy, particularly in their regions. The performance of higher education in innovation varies strongly between EU regions".

This agenda posed the question of how to "design funding systems that encourage higher education to deliver what society needs and reconcile the objectives of effectiveness, equity and efficiency?" (European Commission, 2017, p. 9).

At the EU member state level, university funding is provided through two main channels: project funding and institutional funding.⁴ At present EU funding is allocated to European universities in the form of project funding only. The recent report of the Independent High Level Group on maximising the impact of EU Research & Innovation Programmes chaired by Pascal Lamy, argues for an additional performance based institutional funding stream, to support institutional modernisation in terms of flexibility, user engagement and openness (Lamy et al., 2017, p. 13):

"Europe's universities need urgent renewal, to stimulate entrepreneurship and tear down disciplinary borders. Strong non-disciplinary collaborations between universities and industry should become the rule and not the exception. The post-2020 EU R&I programme needs to provide incentives for the modernisation of universities. A clearly-defined 'European university' label could reward research and higher education institutions which actively and successfully promote open science, open innovation and openness to the world, i.e. through new ways of teaching, promoting cross-disciplinarity and entrepreneurship whilst attracting researchers and students from around the world. The EU could, in return, offer top-up funding for certain institutional costs at those universities." [Underlining by authors]

The design of governance structures and funding mechanisms strongly influences the way universities position themselves, as they provide both incentives for individual students and staff, as well as the organisation as a whole. National and regional governments have attempted to strengthen the innovation-related activities and economic impact of universities ('innovation impact performance' in short) in various ways, including targeted project funding, performance agreements and to a lesser extent through the inclusion of innovation performance parameters in *performance based funding* systems (Jonkers & Zacharewicz, 2016). A number of countries have set up an assessment system with purely quantitative data to feed into the funding formulae. These performance metrics tend to focus primarily on a few knowledge transfer mechanisms and can, for example, include: number of university patents, revenues from contract research, and public private co-publications. Instead of a metrics-based approach, there are also countries which rely on a more qualitative assessment of impact cases submitted by university or university groups. Finally, some other countries refer to a third 'hybrid' system where peer-review 'qualitative' assessment methodologies are supplemented by quantitative indicators and performance metrics.

This report is embedded in a wider innovation-oriented agenda and reflections on ways to promote the contribution of universities to regional economic development. In particular it aims to outline a potential assessment system of university innovation performance on

⁴ Project funding refers to funding of a group or an individual to perform an R&D activity limited in scope, budget and time, normally on the basis of the submission of a project proposal describing the research activities to be done." (Van Steen, 2012). Institutional (organisational level) funding is attributed to a research performing organisation (university or PRO), with no direct selection of R&D project or programmes and for which the organisation has more or less freedom to define the research activities to be performed. (Van Steen, 2012). Institutional funding can be provided as a block grant or in a competitive manner, e.g. on the basis of ex post performance assessments (performance based funding).

which performance-based funding allocation decisions can be based. The report summarizes some national practices in Europe and gains valuable insights from the available technical literature, as well as from studies carried out for national and EU policy makers. It will focus on the general feasibility of a system to assess contributions and impacts of universities to their *regional innovation systems* (Cook et al., 1997).

The design and implementation of a *regional innovation impact assessment* (RI²A) system could set a path for EU level performance based funding to universities which resonates with the above-mentioned 'modernization' recommendation from Lamy et al. (2017). Such an instrument could form a significant share of institutional funding to universities, perhaps up to 10-15% (for example). It should crucially be supplementary to existing research funding, i.e. there should be no trade-off between research funding and innovation funding. Furthermore universities should not be forced to apply for funding if they deem innovation activities not to be sufficiently in line with their mission. The RI²A framework may also be used by universities, national or regional governments to assess the contribution of universities to the innovation performance of the system in which they operate.

The outline of an evidence-based RI²A system, as described in this report, is comprised of three main analytical components:

- quantitative, metrics-based indicators to measure innovation impact and monitor its dynamics ('numbers');
- qualitative contextualisation of these indicators potentially supplemented with qualitative evidence of specific impact incidences ('narrative');
- integrated analytical framework that focusses on the geographical dimension of impacts.

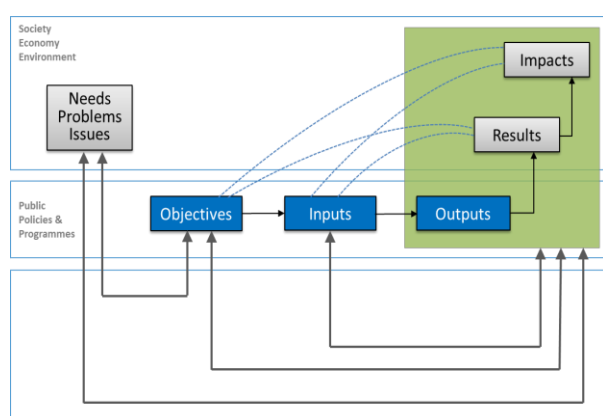
Unlike the HEInnovate tool, co-developed by DG EAC and the OECD, the RI²A system proposed in this report is not meant for university self-assessments. HEInnovate is very useful as a formative tool to allow universities to explore their entrepreneurial and innovative potential. The approach outlined in this report proposes to supplement the HEInnovate work by offering universities incentives to engage in this modernisation process. In the RI²A approach, the university is responsible for drafting a convincing case study. This should crucially be assessed by an international panel of independent experts. This is necessary to justify the use of RI²A as a basis for funding decisions. Universities using the HEInnovate tool successfully may be better prepared to develop their case studies and more likely to perform well in the framework of RI²A assessments.

2 Methodology

2.1 Conceptual models and analytical frameworks

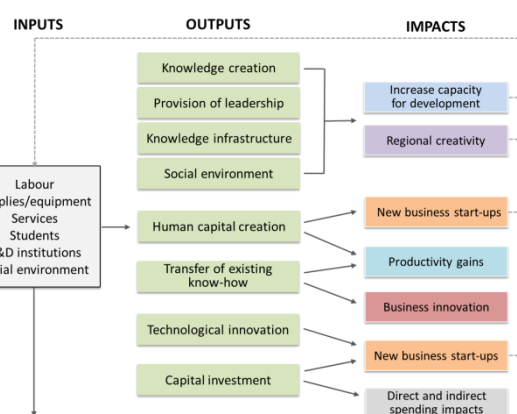
In order to identify innovation impacts, it is crucial to understand science-innovation systems. As a whole and how improvements to such systems might deliver those impacts. Ideally, one can trace innovation impact back to a single 'make or break' event, such as the first publication about a scientific discovery or patent application of a breakthrough technology, or perhaps even the source of the original idea. In practice, the timeline and causality is unclear and impact will often be generated by complex interplays of many sources and (hidden) determinants. Sometimes, chance plays a decisive role. One of the most commonly used analytical models of such impact generating processes, especially designed for performance evaluation of non-profit programs, is the 'logic model' (Weiss, 1972; Kellogg Foundation, 2001).

Figure 1 Logic model of impact generating processes



Source: adapted from Technopolis Group (1999) (2004)

Figure 2 Contributions of universities to regional economic development



Source: adapted from Goldstein and Renault (2004)

Figure 1 displays a graphical representation of the Logic model, embedded in the broader context of mission-oriented programs driven by societal needs, problems and issues. There is an implicit time-line in this one-directional 'linear' model. The variant on display clarifies the important distinction between outputs, results and impacts. While this model implies that 'impacts' may lie further in the future, it also specifies shorter-term 'outputs' and 'results' that provide an indication of progress toward long-term objectives. It often takes many years before an identifiable innovation impact emerges. By then it may prove almost impossible to track its exact provenance and attribute to it a specific university as source of origin.

The UK government for example accepted that it is impractical, if not impossible, to unambiguously measure the socioeconomic impact of university research. This has led to the decision to focus on impact pathways⁵. The UK government opted for a qualitative assessment of knowledge transfer activities and other ways to engage key stakeholders and the general public (Research Councils UK, 2011). Other impact assessment initiatives in Europe, focussing mostly on impact pathways to identify societal impacts of research, stress the importance of engaging with relevant stakeholders and interacting with knowledge user communities (SIAMPI, 2010; INRA, 2014; Spaapen, 2017).

⁵ The concept "impact pathway" refers to narrative stories of how a university's activities (e.g. research) led or can lead to a specific impact.

Unlike the Research Excellence Framework (REF)⁶ in the United Kingdom, the approach taken in this report is to focus solely on the impact of universities on innovation and regional economic development. Most existing innovation impact assessments of universities tend to focus on knowledge exploitation activities and outputs, notably on the impact of academic research on business sector R&D and technological innovation, or on academic entrepreneurship and university spin-off companies. However, sophisticated assessment systems could adopt a broader conceptualisation. The 'economic' dimension explicitly includes the component 'education', thus capturing the major impact universities can have on innovation and innovative potential of their region through the provision of tertiary-level teaching and training. The steady supply of human resources from local universities can be a key contributor to regional innovation systems. Universities can also play a role in providing entrepreneurial skills and thus foster the development of new innovative ventures.⁷

We can now tackle the generic concept '*regional innovation impacts*' within the analytical framework of the logic model. The aggregate-level model is depicted in **Figure 2**. This model is one of many possible variants; it mainly serves to illustrate the variety of university outputs and impacts that may contribute to a region's economic development. While some short-term impacts, especially those with obvious 'direct' causal linkages to their university origin, are relatively easy to capture and count (e.g. new business start-ups), most long-term 'indirect' impacts are difficult to unambiguously identify or measure precisely (e.g. productivity gains). In this report this framework is used to assess the innovation impact of university rather than the broader economic impact, although some aspects may be indirectly addressed. Therefore only innovation-related indicators will be considered.

Ideally, one would like to have at least one high-quality quantitative measure for each of the components listed in Figure 2. Unfortunately, the development of performance indicators and metrics of the regional innovation impact of universities is still in its infancy; mainly because operationalization and measurement of '*innovation impact*' is fraught with methodological difficulties (similarly to '*economic impact*'). Apart from classifying impacts on the basis of their time horizon (short term, medium term, and long term impact) one can classify (potential) impacts by four general characteristics of a university's activity profile:

- Education and human capital development;
- Research, technological development, knowledge transfer and commercialisation;
- Entrepreneurship and support to enterprise development;
- Regional orientation, strategic development and knowledge infrastructure.

This categorization and classification system is the backbone of our framework for selecting and organising impact indicators in **Annex 2**, and presenting those performance indicators (from 'Results' or 'Impacts' category as mentioned in Figure 1) in a separate '*indicator box*'.

Such a typology also suggests the design of a 'regional impact matrix', where these impact sources are connected to impact categories. Depending on the aim and level of the assessment (regional, national, EU) in the actual implementation of the RI²A specific weights will be attached to each of the impact categories. In this way universities will be incentivised to deploy relevant activities in these directions and/or support them in expanding their ongoing activities.

⁶ The UK REF, Dutch ERIC, the Australian RQF and the US PART approach all considered broader socio-economic impact, i.e. they include impacts which are beyond the remit of this report which focuses on innovation impacts (Grant et al., 2009)

⁷ It is the latter type of entrepreneurship education that will be the central focus of the RI²A. This kind of entrepreneurship may find its implementation in high tech innovative activities but also in social innovation (e.g. firms in the creative industries domain). Both developments can be of value to strengthening the Regional Innovation System.

2.2 Filling the assessment toolbox

There are various data-analytical methodologies to study the impacts of universities on regional economic development. Most approaches comprise of either case studies, indicator based approaches, surveys, or econometric analyses (Salter and Martin, 2001; Goldstein and Drucker; 2006). Annex 2 describes some of the limitations of surveys and econometrics studies. This section explains the combined approach of case studies supported by quantitative indicators.

The main advantage of the case study approach consists in the ability to collect data on a wide variety of topics, items and subjects (some of which are not amenable to quantification). Case studies largely rely on 'narratives' that tell the story of how impacts were generated. The narratives approach is especially useful for communicating information on such impacts to broader audiences beyond the university. Although case studies are appropriate tools for collecting such qualitative or anecdotal information, they are nonetheless constrained by information availability with regards to deriving quantitative and comparable estimates of innovation impacts. The two main drawbacks are the difficulty of attribution (i.e. determining a causal link between impacts and university activities, outputs and results) and the lack of generalizability (to other universities, regions, or economic circumstances). Case studies avoid some of the information deficits of purely quantitative studies, though at the expense of general comparability. Hence, the ability of case studies to analyse and communicate important features of impact pathways, through a combination of narration and empirical evidence, is critical.

Quantitative indicator based approaches have a number of advantages over purely qualitative approaches. The use of performance indicators and metrics can allow for a more standardised, quantifiable method to assess impacts of a university. However, the selection of suboptimal or too narrowly defined indicators can have negative consequences on the description of both university performance and the innovation performance of the system in which they operate. In order to select an appropriate portfolio of indicators, each proposed indicator should therefore be evaluated, in terms of:

- fairness - degree to which it accommodates key traits and characteristics (specific for country, region, organisation);
- added value - extent to which the indicator introduces a new perspective;
- transparency - extent to which the data, or data processing, can be independently verified;
- independence - extent to which the data is resistant to external manipulation;
- cost effectiveness - costs to obtain the required data, and the expected compliance cost to institutions and government, related to perceived benefits;
- behavioural impact - likely effects on the practice of universities or organisational subunits, and whether that impact is in line with desired managerial or policy outcomes.

These quality criteria are especially important in the case of *key performance indicators* (KPIs) that are designed to compare or monitor the performance of different universities.

Benefitting from their relative strengths, in section 4 we propose a combinatorial approach, where 'narrative-based' case studies are supported by performance indicators and metrics, as a 'best option' choice.

3 Regional Innovation Impact Assessment system

3.1 Design Issues

Building on this framework of general design criteria, the RI²A system needs to operationalize the notion '*university contributions to the regional innovation system*' in terms of addressing the following key questions which regards to its foci:

- 'regional innovation system' in the narrow, self-contained sense, or more broadly and also comprising inbound or outbound spill-over effects of other regions?
- 'innovation impacts' or the broader defined 'socioeconomic impacts'?
- '(technological) innovation within the private sector' or 'innovation within private sector and the public sector'?

For practical reasons the best choice for the unit of analysis is the 'main organisation' (university)⁸, which is not only a generally recognized and meaningful entity, but also of a sufficiently high-aggregate level to ensure the availability of information and enable effective collection of data. The 'university' is also relatively easy to define empirically, although some universities may comprise a 'system' of connected organisations (schools, teaching hospitals, institutes etc.) and affiliated units, which requires careful consolidation into a single unit of analysis.

Universities are multi-input, multi-output organisations which differ in size, nature and mission. Each university is the product of a distinct social, economic and intellectual development process and therefore finds its own balance between teaching, research and a broad range of activities aimed at (potential) innovation impact (Molas-Gallart et al., 2002). It is impossible to apply a 'one size fits all' assessment approach that can be applied equally to for example a leading general research university, a technical university, and a university of applied science. The partially standardized, partially customized assessment system should be sufficiently flexible to cope with a broad range of universities, from a small, specialised university in a low-income rural region in Europe to a large comprehensive university in a high-income national capital. The system should also be able to manage disciplinary differences within and among universities (including interdisciplinary and multidisciplinary research).

In order to assess a university's contribution to the regional innovation system, its RI²A indicator profile should therefore comprise a wide range of data and information, such as for example:

- generic performance indicators (to be applied across all universities – in Europe or per country) ;
- region-specific or sector-specific indicators (by 'type of region' or 'type of university');
- university-specific indicators (to address truly unique features);
- appropriate mix of qualitative indicators and quantitative indicators;
- appropriate mix of potential impacts and observed impacts; volume and size of impacts ('quantity') from intensity and pervasive effects of impacts ('quality');
- relevant background information on the university (goals and identity, core functions and mission, etc.);
- relevant background information on the university's local region (regional employment statistics, number of R&D-active firms in the region, competing universities, etc.).

Europe-wide RI²A systems can benefit from existing classification systems and databases with aggregate-level background information on universities. Two EC-funded data

⁸ As shown in existing national examples, such as the REF in the United Kingdom, assessments could also be carried out at the sub-organisational level of research groups, or even the level of individual researchers as in the case of the Spanish Sexenio's.

collection initiatives, *ETER*⁹ and *U-Multirank*¹⁰, offer such databases which also enable to evidence-based selection processes to engage in 'like with like' impact analysis of comparable main organisations.

3.2 Delineating the geographical region

Any RI²A system should include a meaningful operationalization of a university's 'local region'. How to delineate a region's exact location and its geographical boundaries? A European region, as a geographically bounded area, is usually operationalized in terms of the NUTS classification system which divides each of the EU member states into mutually exclusive administrative units at three levels (NUTS1, 2 and 3) mainly for producing European regional statistics. These units do not necessarily correspond with general perceptions of a region in terms of economic zones: some large capital cities (London, Paris) comprise several NUTS3 regions, and the NUTS system does not include transnational regions (such as the Oresund region that connects Denmark and Sweden).

¹¹

While the focus lies on assessment of regional innovation impact, the extended impact of universities in their home country, in other parts of Europe, or even worldwide should not be ignored. Given the increasingly important objective to stimulate inter-regional collaboration, the assessment system will explicitly also consider the impact of universities on innovation beyond their own region. Moreover, the regional impact of a university does not necessarily flow from an exclusive orientation on its home region; large universities with a global reach can be major attractors of economic activity to the local environment.

Contextualisation is essential. Regional economic development level and pre-existing absorptive capacity¹² in a region influence the potential of a university to have an innovation impact. Also the national/regional institutional context can determine what type of activities a university is allowed to develop. Therefore, the RI²A system also requires background information on the region's economic profile and institutional context. To this end, the cases could be supported with indicators analysing the regional economic development level – e.g. indicators used in the Regional Innovation Scoreboard.

3.3 Selecting the performance indicators

The Indicator Boxes in Annex 2 assemble a series of potential (interrelated) indicators that capture key domains of a university's impact profile. The current lists of indicators in the right column of each box are tentative and non-exhaustive; they include indicators of potential impact (capturing the category 'Results' – see Figure 1) as well as indicators of

⁹ The European Tertiary Education Register (ETER) is a database of higher education institutions in Europe. ETER provides detailed data on 2,465 higher education institutions hosting more than 17 million students at Bachelor, Master and PhD level. Covering 32 European countries, the data includes university size, number and gender of students and staff, subject areas and degree levels, as well as information about research, international students and staff, and funding (ec.europa.eu/education/resources/european-tertiary-education-register_en; www.eter-project.com)

¹⁰ U-Multirank is a transparency tool to compare and rank the performance of higher education institutions worldwide, according to multiple dimensions and a large range of performance indicators (www.umultirank.org)

¹¹ Relying entirely on the NUTS system is likely to misrepresent the nature and extent of a university's regional economic impact, thereby unduly constraining the analytical power of a RIA system. Applying a university-customized definition of a 'region', alongside a standardized NUTS definition, offers opportunities to capture impacts outside the immediate geographical environment or country borders. While the first definition will be important for regional policy-makers that could play a role in the implementation of a PBF system, this does not preclude universities from arguing how their activities contribute to innovation in a geographical region that can span different NUTS administrative regions. An alternative operationalization is distance-based, where a radius around a city or town (in kilometres) determines the local region's geographical perimeter and size.

¹² A university operating in a low tech region has a different potential to generate innovation impact than a university operating in a high tech region with many firms demanding the knowledge and skills it generates.

observed impacts (the 'Impacts' category in Figure 1). While some indicators may be of a qualitative nature, deriving their non-numerical data from case studies or other 'narrative' sources, other indicators are quantitative and comprise of metrics. Universities and/or regional governments should select appropriate indicators from each of the four boxes to support their university case studies.¹³ The selection of these indicators has been based on a number of sources, including knowledge tools funded by the European Commission such as HEInnovate¹⁴, EUnivation¹⁵ and U-MultiRank¹⁶, as well as Mollas-Gallart et al. (2002) and other parts of the academic literature.

Annex 2, presents those (tentative and non-exhaustive lists of) performance indicators in a separate '*indicator box*' for each of the four impact categories.

For the **education and human capital development** impact category and associated indicators we propose to focus on entrepreneurship education, the involvement of business in curriculum design and/or the involvement of regional business in selecting and supervising BSc, MSc and PhD dissertations (industrial PhD programmes), etc.

For the **Research, technological development, knowledge transfer and commercialisation** impact category and associated indicators we propose to focus on classical knowledge transfer indicators related to e.g. consultancy and contract research, IP, collaboration with regional private partners, intersectoral mobility of staff, industry funded research positions and share R&D facilities.

For the **Entrepreneurship and support to enterprise development** impact category and associated indicators we propose to focus on the activities of industry liaison and technology transfer offices, business indicators and accelerators, the establishment and growth of spin offs, access to seed funding and venture capital, science and technology parks and other business related infrastructure, facilities and services.

For the **Regional orientation, strategic development and knowledge infrastructure** impact category and associated indicators we propose to focus on profiling to reflect regional specialisation and objectives; involvement of the university in regional innovation strategy setting, the contribution of the university to the regional knowledge infrastructure; capacity for regional socioeconomic development and income generated from regional sources.

Universities should try to draft a convincing analysis, a case study that is to be assessed by independent panels of experts. They may not need all the indicators proposed in Annex 2, and additional evidence may be introduced drawn from, for example, national statistical data sources. Some indicators are covered, for a large number of European universities, through U-Multirank. The EUNIVATION project provided useful indicators especially for Box A (Education and human capital development). As indicated by stakeholders, this box could be further developed in the future, for example by taking into account performance indicators for assessing the degree to which universities foster creativity or interdisciplinary.

3.4 Methodological challenges

Apart from the obvious challenges to determine cause/effect relationships and attribute effects to a university, the measurability of impacts is clearly one of the fundamental methodological limitations mainly because of:

- the difficulty of expressing some innovation impacts in terms of monetary value;

¹³ University self-assessments are necessary for collecting qualitative information and for contextualising the indicators. It would be preferable to derive the quantitative indicators from quality assured sources such as the aforementioned ETER and UMR data collection exercises (Debackere et al., forthcoming).

¹⁴ <https://heinnovate.eu/en>

¹⁵ <https://eunivation.eu/>

¹⁶ <https://www.umultirank.org>

- university sources of information may not be aware of (potential) impacts or have incomplete information of their effectiveness;
- additionality/attribution problems: it is problematic to unequivocally determine whether a university action has resulted in a specific innovation impact without 'counterfactual' information on what would have happened without that university's action (Molas-Gallart et al., 2002);
- serendipitous nature of outputs, results and impacts: it is not only the quality of the effort but also environmental factors, such as timing and the business cycle, as well as luck which affect the occurrence and degree of innovation impact (Molas-Gallart et al., 2002);
- impacts of more radical breakthroughs may only become apparent a long time after the university has engaged in the efforts;
- major impacts are highly skewed, where the occurrence of a single scientific breakthrough would greatly influence the assessment of a university's performance, crowding out other substantive activities of a university, whereas those universities without a such achievements would appear to underperform (Molas-Gallart et al., 2002);
- analytical intractability: if a university is already intricately interconnected to its regional innovation system, and closely interacting with other mutually-dependent actors in that system, one cannot assess the (potential) innovation impacts of a university in isolation of (other changes in) that system;
- accounting for collaboration and networks: contributions by a university's partners may go unnoticed or are undervalued and incorporating the effect of cross-border spill-overs (impacts could be partially the result of investments, activities or outputs outside the region).

Although metrics-based indicators tend to carry a greater degree of objectivity and comparability, they come with various caveats in terms of validity, reliability and relevance. It may prove difficult for a university to collect information on its actual innovation impacts in the region. It can however be more straightforward to compile evidence of the investments and organisational efforts it has put into creating an environment for the creation of outputs and results with a potential for innovation impact. Within case studies universities would therefore be encouraged to analyse the intensity and quality of the efforts, while also reporting evidence of the actual impact of the activity, where this is already available.

The proposed system should attempt to attain a great degree of inclusiveness (as many (potential) impacts as possible, but in its implementation this needs to be weighted with the costs of collecting and assessing these impacts.

4 University case studies: 'narrative with numbers'

The proposed approach aims to build on the strengths of the metrics and narrative approaches in order to present illustrative case studies of the impact of universities on their regional innovation ecosystems. In view of the fact that several (potential) impacts can only be captured with qualitative information, rather than indicator-based statistical data, the most appropriate way to describe the outcomes of each RI²A exercise of a university is a 'narrative with numbers' framework. In other words, as a narrative case study supported by indicators to identify, categorise and explain the (potential) impact they have on their regional innovation ecosystem. This 'multi-method, multi-sources' approach has a number of advantages over purely qualitative case studies as they allow for a greater degree of objectivity, comparability and tracking of progress over time. The case studies need to be conducted by qualified experts and reviewed by expert panels.

The 'narrative' mode comprises a review by a carefully selected group of experts. Adopting the whole university as a unit of analysis, rather than organisational subunits or university programs, requires expert evaluators with sufficient knowledge of the entire university and its region, as well as an appropriate skill set. It is clear that an expert panel should be sufficiently broad and diverse to incorporate the necessary differences in background. Scientific peers are not necessarily good at judging socio-economic impacts (Debackere et al., forthcoming). While academics are conditioned to accept peer review when it comes to the assessment of scientific merit and impact, it is less clear to what extent this acceptance holds when it comes to regional innovation impact – which is a new, uncertain and ambiguous evaluation object. The notion of 'innovation impact' is not as well understood as 'scientific impact'. The fact that key concepts and notions are still in flux, and may not be understood the same by all experts, suggests the application of expert panel reviews, which allows for contesting and conflicting opinions which can be played out and negotiated for consensus seeking (Derrick, forthcoming).

As the UK REF shows, the costs involved in the large scale assessment of impact cases¹⁷ can be substantial and the effort complex, subjective and time consuming. Any realistically feasible RI²A system should not be overly costly in terms of resources (time and money). This holds both for the universities preparing the impact cases, but also for operating the assessment system. It may also be difficult to identify and recruit reviewers with sufficient expertise for the Group expert reviews. A possible solution to the problem of finding appropriate experts and reviewers is to tap into EU pool of experts that can be called upon to carry out assessments of universities on behalf of the European Commission or national/regional level governments in case the allocation/implementation decisions occur at that level.

In feeding the results of the assessment into a funding formula it is important to ring-fence a given percentage to each of the four impact categories¹⁸, corresponding to the indicator boxes, within the context of the university's regional development level. This ring-fencing will ensure that the different dimensions through which a university can impact on the performance of regional innovation systems are all incentivised.

¹⁷ A potential part of university level 'narratives with numbers' are case studies of individual economic impacts or impact pathways that (may) lead to a specific impact (INRA, 2014; Spaapen, 2017). These selected cases can involve examples of particularly strong impact on a firm, public sector organisation, a specific economic sector, or on the whole regional innovation system. The case studies that are proposed should include a historical baseline of a limited number of years ago and show the contribution of the university on progress since then. While the cases should focus on innovation impact, the nature of this contribution can be broadly conceived and include e.g. the impact that a university has on the innovation potential of firms in its region through the provisions and attraction of appropriately trained human capital. However, considering the *"diversity of impact pathways and mechanisms combined with a lack of a standard way to describe or measure impact makes implementation of impact assessment [in performance based funding systems] difficult"* (Debackere et al, forthcoming).

¹⁸ These categories are: (1) education and human capital development; (2) research, technological development, knowledge transfer and commercialisation; (3) entrepreneurship and support to enterprise development; (4) regional orientation, strategic development and knowledge infrastructure,

5 Concluding discussion

Developing an effective assessment tool to capture and interpret regional impacts of universities requires sophisticated explanatory models and large databases that capture knowledge flows, identify impact pathways, and analyze complex causalities.

Evaluations can have both a summative and a formative nature. The former aims to assess performance whereas the latter primarily aims to provide guidance to universities to improve performance. The Logic model (see Figure 1) can and, indeed, should be used to help design both formative assessments (during implementation of RI²A) and summative evaluations (after its completion). However, rather than adopting this model's linear view as a framework for interpreting the findings of a RI²A, it is better to adopt a 'systems of innovation' approach, considering a wider range of the determinants of innovation (including the demand side in local industry).

Given the wide variety of universities and regions in Europe, one should avoid a 'one size fits all' RI²A system. Appropriate customization should be based on a classification by type of university (mission, size and scope) and type of region (economic profile and level of development). Each university/region category should be assessed according to its own (preferred) set of indicators and (potential) impacts.

A carefully designed series of pilot studies is required to test and refine such a diversified RI²A system. It is better to test a trimmed-down version of such an assessment system, with a relatively small number of generally-accepted KPIs and a focus on particular (potential) impacts, than a fully-fledged version. The chance of failure (operational costs, non-compliance, flawed or incomplete data) increases with the degree of complexity.

If an RI²A-based funding mechanism is to be implemented in due course – open for all universities in all European regions – how should one allocate funds to individual universities according to a performance template that is pre-defined by the funding agency? Important policy questions that need to be addressed in the design and implementation of a RI²A based funding mechanism include:

- Does the system require some degree of formal commitment from the region (matched funding?)
- How to make it sufficiently attractive for universities to apply (and their regions to support such applications)?
- Is there a need to include mutually-binding 'performance agreements' (i.e. university and region)?
- How to keep the data collection efforts and administrative burden (for the universities and the funding agency) at an acceptable low level?
- How can the system be designed to create sustainable effects in the region (e.g. demand articulation) and leverage additional incentive systems within the universities (e.g. financial rewards or career trajectories)?

The RI²A system would benefit from being both evidence-informed and behaviourally informed. Rather than (over)emphasizing the actual or potential innovation impact of universities, alternative approaches should also try to provide a deeper understanding of the many drivers (cognitive, social, perceptual, motivational, and emotional) that guide their objectives and everyday actions in the setting of regional innovation systems.

The European Union has launched the concept (and funding) for conducting '*responsible research and innovation*', which includes the concept of public engagement (Competiveness Council, 2014). One of the most conclusive findings of different impact assessment studies is the importance of stakeholder engagement and leadership in research. These objectives chime with the promotion of stakeholder involvement through the provision of institutional funding to universities on the basis of their impact of regional innovation systems. It also suggests the importance of stakeholder involvement in the design of the RI²A systems.

Critical reflection on how an RI²A system should be implemented, and gaining a buy-in from key stakeholders, could benefit from organising a series of 'co-creation workshops' where participants can jointly develop (hypothetical) cases studies with different modalities of RI²A systems.

Some important considerations are:

- funding should be supplementary: there should be no trade-off between research funding and innovation funding;
- universities should not be forced to apply for funding if they deem innovation activities not to be sufficiently in line with their mission;
- not all disciplines have the same potential for innovation impact (e.g. distinguishing between general and technical universities is required).

The narrative approach proposed in this report is not the only type of assessment that is possible. Alternatives include for example the exclusive use of metrics or panel reviews of qualitative case studies only. It would also be possible to use academic peers rather than expert panels to review the university cases. However, it is beyond the scope of this report and discussion paper to provide a detailed analysis of the strengths and weaknesses of these alternative approaches. It is safe to say that both the exclusive use of quantitative indicators and metrics or the exclusive use of qualitative case studies each have their shortcomings. Some of these limitations and disadvantages can be overcome in the combined approach proposed here which offers better opportunities to produce high-quality verifiable information on a university's regional innovation impact.

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Annex 1 Explanation to discard alternative impact assessment approaches

Apart from Case studies and indicator based approaches one could consider large scale surveys and econometric studies to assess the impact of universities. Below we explain for both approaches why we do not include them at this stage.

The *survey approach* is distinguished by its application across multiple universities and other units of analysis, thus establishing generalizable results with greater external validity. Surveys are appropriate platforms to gather indicator-based information that can support the narrative with number case studies, but they may suffer from validity threats such as response biases and respondent ignorance especially when the questions aim at the attribution problem e.g. what exactly caused the impact?

Econometric studies are model-based quantitative studies. As such they are more easily generalizable than case studies. Most of the economic modelling and econometric analyses concentrate on university expenditure data or technological innovation outputs of universities (e.g. Biggar Economics, 2017). Measurement and data availability issues limit the ability of econometric studies to separate the innovation impacts of the above outputs from the impact of other university outputs and results (e.g. human capital). This can result in neglecting other demonstrable contributions of universities to regional economic development. Moreover, restrictive assumptions underpinning the econometric model and the limited suitability of quantitative indicators for capturing complex concepts, provide an analytical framework of limited statistical robustness. Since econometric approaches to impact assessments tend to be difficult to justify empirically they are considered less useful for convincing assessment of (potential) regional innovation impact.

Annex 2 Overview of Innovation Impact metrics

The two fundamental activities of universities are: (a) production of human capital and (b) creation of intellectual capital. In doing so, these organisations tend to have wide and far-reaching impacts on the local economy. On top of their knowledge creation activities and outputs, many universities also work to transfer existing knowledge and technologies directly to the business sector, or through investments of local business enterprises for joint R&D with universities. Research commercialisation, intellectual property licensing and spin-out companies are three of the key channels where universities contribute to regional innovation.¹⁹ By creating new businesses the universities directly support innovation activities. Spin-out and start-up companies create jobs and generate revenues from products or services sold in the marketplace.

A university should be able to provide comparative data on monies earned in the marketplace, especially income flows from business corporations or from other business activities such as license income from university-owned patents. Universities contribute to human capital development through teaching, training and research, the outputs of which provide a flow of graduates for the local, regional (or national) labour market, which may contribute to the innovation potential of the regional economy. Assessing the innovation impacts of workforce training requires the tracking of people into the job market and civic society. Universities also have a role to play in the production of regional knowledge infrastructures, as a result of positive agglomeration effects. For instance, research institutes or companies choose to locate in close proximity to universities in order to benefit from informal knowledge sharing as well as face-to-face contact with academics involved in research. Cities or regions with several universities often also have associated knowledge infrastructures, such as science parks, which can ultimately develop into knowledge clusters, innovation hubs and regional innovation systems.

The role of the university in contributing to the regional innovation system can extend beyond its main organisational missions and the use of its main outputs and products with economic value (human resources, knowledge, skills, technologies). Increasingly universities are expected to play an orchestrating role in bringing different public and private actors together in innovation activities and in the development of regional strategies to set an institutional framework that is conducive to such processes. The boxes below provide an overview of potential indicators to capture the impact dimensions in figure 2 as outlined in sections 2 and 3.4. They are principally based on a review of existing studies including Molas-Gallart et al. (2001), HEInnovate (2017), EUNIVATION (2017). The list of indicators in each box refer to elements of the 'Results' or 'Impacts' category as mentioned in Figure 1.

As an emerging area, there is still much to be done to advance the 'art of impact assessment', to develop analytical tools, as well as providing practical implementation solutions. In the context of developing an RIA system, the following issues still need to be addressed to lay the groundwork for a '*regional innovation impact profile*' of each university:

- agreement on a comprehensive list of performance indicators, and on a minimum set of 'key performance indicators' drawn from that list that will inform the final data framework;
- additional quality criteria for choosing (and rejecting) indicators;

¹⁹ While the focus lies on assessment of regional economic impact, the extended impact of universities in their home country, in other parts of Europe, or even worldwide should not be ignored. Given the increasingly important objective to stimulate inter-regional collaboration, the assessment system will explicitly also consider the impact of universities on innovation beyond their own region. Moreover, the regional impact of a university does not necessarily flow from an exclusive orientation on its home region; large universities with a global reach can be major attractors of economic activity to the local environment.

- 'good practice' protocols for selecting key performance indicators which can answer stakeholder questions; recommending 'good practice' indicators for specific impact categories.

Indicator Box A: Education and human capital development (with a regional orientation)	
Inputs	'Results' indicators and 'Impact' indicators
<ul style="list-style-type: none"> • Grants and scholarships for students from local/regional private sector • Credit bearing courses established through a direct request or with the involvement from non-academic local/regional organisations; • Tailor-made academic programs in partnership with businesses • Participation non-academic agents in curricula design • Joint PhD Programmes and industry sponsorship of post graduate education • Entrepreneurship teaching and learning; skills development • Inter-sectorial mobility of teaching staff • Labour outcomes and student satisfaction post-graduation • Regional student retention • Life-long learning and non-academic education • Graduate tracking of salaried employment 	<ul style="list-style-type: none"> • Entrepreneurship education: number of students enrolled in entrepreneurship courses as % of total students and/or the number of students attending internship • Number of faculty members taking a temporary position in a non-academic organisations; • Number of employees from non-academic organisations taking temporary teaching and/or research positions at university • Labour outcomes and postgraduate labour surveys that measure satisfaction with knowledge gained at university • Student internships in the local region: out of the students who did an internship, the percentage where the internship was with a company or organisation located in the region • BA theses with local/regional organisations: degree theses of bachelor graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region • MA theses with local/regional organisations: degree theses of master graduates done in cooperation with organisations (industry, public, non-profit organisations) in the region • % academics teaching in courses required by local/regional firms; or income received from non-credit bearing teaching and associated activities for local/regional clients • Graduate employment: percentage of graduates working in the region after graduation • Wages of university graduates (3-5 years after graduation)

Indicator Box B: Research, technological development, knowledge transfer and commercialisation (with involvement of local or regional partners)

Inputs	'Results' indicators and 'Impact' indicators
<ul style="list-style-type: none"> • Research activities • Knowledge and technology transfer • Consultancy and contract research • Collaboration with regional private partners • Inter-sectorial mobility of research/teaching staff • Industry funded research positions • Shared R&D facilities • International staff 	<ul style="list-style-type: none"> • R&D related income from local/regional private sector • Resources generated from contract research and consultancy work local/regional industry • Strategic research partnerships in the region • Regional partnerships of the Tech Transfer Office • Patent (applied/granted), licensing income from local/regional industry • Regional joint research publications within local/regional industry • Shared R&D facilities with local/regional industry • Mobility of university staff to or from local business enterprises • Research staff with a dual affiliation at local/regional business enterprise • Industrial PhDs that involve local/regional industry; % of PhDs undertaken jointly with private actors or the number of postgraduate students directly sponsored by local/regional industry R&D prizes and innovation prizes awarded by local/regional industry • Professorships or other university positions (partially) funded by local/regional industry • Public private co-publications

Indicator Box C: Entrepreneurship and support to enterprise development (within the local region or with involvement of local or regional partners)

Inputs	'Results' indicators and 'Impact' indicators
<ul style="list-style-type: none"> • Industry liaison offices, knowledge and technology transfer offices; • Business incubators, and accelerators • Access to seed funding and venture capital • Science park, technology park or innovation hub • Other business-related infrastructure, facilities and services 	<ul style="list-style-type: none"> • University spin-off and start-up companies (number of, employment generated, turnover) • Student start-ups (number of, employment generated, turnover, private funding raised, nature of university support) • Investments of industry or public sector partners

Indicator Box D: Regional orientation, strategic development and knowledge infrastructure (with involvement of local, regional, national or foreign partners)

Inputs	'Results' indicators and 'Impact' indicators
<ul style="list-style-type: none"> • Profiling to reflect regional specialisation and objectives • Involvement in regional innovation strategy setting • Regional knowledge infrastructure; • Capacity for regional socioeconomic development 	<ul style="list-style-type: none"> • Income from regional sources: proportion of external research revenues – apart from government or local authority core/recurrent grants – that comes from local/regional sources (i.e. industry, private organisations, charities). • Joint agenda setting with regional partners • Profiling strategies (PR and marketing) related to regional needs and specialisations • HRM and staff performance assessment related to regional needs and specialisations • Formation of social ties and networks with local/regional stakeholders and partners • Contributions to the creation of a local/regional entrepreneurial ecosystem • Contribution to embedding the regional innovation system in international R&D networks (international co-publications; participation in international research projects; attraction of foreign staff) • Contribution to the investment climate (attraction of private investments in the region e.g. by foreign or national firms)

Annex 3 Indicators of regional innovation context

The innovation performance of a university is heavily dependent on the regional innovation system in which it operates. High tech regions have different levels of absorptive capacity and needs to which a university can cater than regions with different levels of economic development. Universities operating in regions without the presence of a well-developed high tech industry, additional knowledge infrastructure of a highly skilled human capital base can still have a positive influence on the development of their regional innovation system. Nonetheless, in order to make the RI²A system sufficiently flexible to cater for the assessment of different types of universities operating in different regional context and thus enhancing its potential usefulness for also incentivising universities operating in less advanced economic regions, it is necessary to allow the university to contextualise its performance. One approach to do this is to request the university to explain its performance relative to the regional innovation system in which it operates. The description of the regional innovation system will most likely again be based on a qualitative narrative description supported by indicators. The Regional innovation scoreboard developed for the European Commission may offer universities a starting point for the collection of these indicators of the development level and evolution of their region over time (Hollanders & El Sadki, 2017).

Indicator Box: Regional Innovation System	
Inputs	'Results' indicators and 'Impact' indicators
<ul style="list-style-type: none"> • Framework conditions (human resources, attractive research systems, innovation friendly environment) • Investments (finance and support; firm investments) • Innovation activities (innovators, linkages and intellectual assets) • Employment and sales impacts 	<ul style="list-style-type: none"> • Percentage population aged 30-34 having completed tertiary education • Percentage population aged 25-64 participating in lifelong learning • International scientific co-publications per million population • Scientific publications among the top-10% most cited publications worldwide as percentage of total scientific publications of the country • R&D expenditure in the public sector as percentage of GDP • R&D expenditure in the business sector as percentage of GDP • Non-R&D SME innovation expenditures as percentage of total turnover • SMEs introducing product or process innovations as percentage of SMEs • SMEs introducing marketing or organisational innovations as percentage of SMEs • SMEs innovating in-house as percentage of SMEs • Innovative SMEs collaborating with others as percentage of SMEs • Public-private co-publications per million population • EPO patent applications • European Trademark applications • Design applications

	<ul style="list-style-type: none"> • Employment in medium-high and high tech manufacturing and knowledge-intensive services • Exports of medium-high and high technology-intensive manufacturing industries • Sales of new-to-market and new-to-firm innovations as percentage of total turnover (for SMEs only)
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Annex 4 Fictional examples of university level case studies

This annex consists of two case studies of fictional universities that serve to exemplify how the proposed "narrative with numbers" case study proposed in this report, could be constructed. Whereas the examples aim to be realistic they are not based upon actually existing universities and any resemblance to existing organizations is purely coincidental should therefore be disregarded. The two case studies that we consider are:

- Annex 3a) a technical university in a 'high tech' region of Europe;
- Annex 3b) a comprehensive research-intensive university in a European capital city

Many other (sub)types of universities, including e.g. a university of applied science, could also have been considered and in a follow-up to this report we will develop both fictional as well as real cases of such universities.

As was suggested in the report, the case studies will not report on all the indicators proposed in the indicator boxes. However, an attempt was made to provide sufficient quantitative evidence of the innovation impact for each of the four boxes proposed. In reality universities would probably resort to less or different indicators to explain the impact they have on the development of their regional innovation ecosystem.

Apart from indicator based evidence, each case study provides "qualitative evidence of individual impact incidences" which are presented in boxes. In a real case, impact incidences can be further elaborated either in the main text or in an annex to the case study. An attempt was made to keep the example of a university level case study relatively short, around 6-10 pages. This length is arbitrary and policy makers or universities may choose differently.

These are fictional examples of what a case study could look like in practice. The case studies are not intended as templates on which universities should model their assessment, but mainly serve as illustration.

Annex 4a Case study of "University Alpha"

Technical university located in one of Europe's 'high tech' regions

Introduction of the university in its regional context

University Alpha has a long tradition of teaching and training large numbers of engineers for the country's thriving 'high tech' manufacturing industries (especially in the IT sector and biotechnology). The country is classified as a strong innovator in the European Innovation Scoreboard and the region in which the University is based is classified as an innovation leader in the Regional Innovation Scoreboard. Apart from university Alpha, the region hosts two large specialized national research institutes and a university of applied science.

University Alpha ranks among the world's 100 leading universities in several of the major university rankings, and is in the top 5 in selected fields like civil engineering, industrial biotech and micro-electronics. The university has co-evolved with its metropole and local region, which is characterized by a strong micro-electronics sector and a world leading biotech sector. The region's automotive sector also used to be a strength, but this activity has largely disappeared over the past two decades. Furthermore, university Alpha is a world leader in the training of civil engineers which construct bridges and tunnels throughout the world - both as employees of the country's leading engineering firms, but also for companies in other parts of Europe and elsewhere across the globe.

The university does not only have strong ties to the large multi-national companies that are active in its city agglomeration and local region, but its researchers and alumni have also launched several high tech companies that have sprung up in this region over the past fifteen years. Especially in the past eight years, some of these firms have succeeded in growing rapidly and creating a new high tech cluster.

Industry plays an important part in the university's leadership. Thirty percent of university board members derive from industry. These members elect among others the university president and thus have a considerable say in the governance and strategy of the university

These developments, and the various contributions of university Alpha in its regional innovation ecosystem are outlined in the following four subsections of this annex, which are classified according to the four impact categories presented and discussed in the report and its annex 1.

University Alpha: key facts and figures

	2005	2015
Budget	200 million euro	270 million euro
# staff (FTE)	5000	7500
# of research staff (FTE)	3500	5400
# students	45,000	47,000
# publications	19,000	20,000
% top 10% publications	18	19

1. Regional orientation, strategic development and knowledge infrastructure

The regional government and regional industry consider the university to be a crucial part of the regional knowledge infrastructure and 'innovation ecosystem'. University Alpha works closely together with the national research institutes and the local university of applied science. Collaboration with industry is, as is common for technical universities, well above the average in the national research system. In comparison to other technical universities in the country, university Alpha's co-publication rate with industry (7%) and private funding for its research is relatively high (as is discussion in section 3). The university generated 25% of the funding of its R&D projects through contracts with regional firms in 2010-2015 –

2013: NewYeast invests 40 million in new R&D facility in region Alpha

The Japanese world leader in biofermentation of antibiotics and fine chemicals "NewYeast" decided upon setting up its European R&D facility in the region Alpha. Its CEO cited the availability of highly skilled Human Resources, the successful biotech cluster with links to emerging R&D partners and the strength of University Alpha and its pre-existing collaborative ties with university Alpha as reasons for selecting the Alpha region as the location for its investments

up from 20% in 2005-2010. A leading foreign firm in the fermentation industry cited the presence of the university as one of the main reasons for investing 40 million in a new R&D facility in 2012 (see box). The university plays an important role in embedding the regional innovation system in international R&D networks. 20% of its Master students are foreigners as well as 45% of its PhD and Postdoc population, and 20% of its faculty (up from 10, 30 and 15% in 2005-2010 respectively). Approximately one out of four foreign Master students, PhDs and postdocs are recruited after graduation by local firms. Another quarter continues working at the university. As such, university Alpha thus plays an important role in attracting and retaining talent for regional development. The university maintains links with its former alumni and other collaborative academic partners throughout the world. The university's research networks are very international and span more than 100 countries: the share of internationally co-authored research publications in its total publication output was close to 45% in 2010-2015 up from 42% in 2005-2010.

While University Alpha clearly brands itself as a leading global university, in its mission statements and marketing it also refers to its regional role and the contribution it brings to the regional innovation ecosystem. Perhaps surprisingly for a leading international university, 70% of its domestic student body comes from inside the region in which it operates – upon graduation a similar share, though not necessarily the same individuals, is employed in the region. The university leadership actively cultivates links with management and human resource departments of the large and medium-sized firms in the region. It consults these organizations in its strategy setting process and stimulates its staff to develop collaborative ties with firms (in the region and beyond).

The university participates in various innovation and technology networks that play a key role in the creation of the local knowledge economy. University Alpha plays a constructive role in the development of innovation policy in region Alpha by actively collaborating with the local government, amongst others with respect to designing a new policy for high tech clusters. These efforts occur at various levels, from the immediate vicinity of the university to regional government agencies, to the wider (cross-border) region, and to European institutions for the framework programme and the EIT (it is member of two EIT KICs). Locally, the university very regularly consults with the city and the government of the Alpha regions on the extension of science parks and incubators, including efforts to promote the region as a knowledge hub to attract foreign companies. At the regional government level, the university collaborates with the research and innovation funding agencies, the Ministry of Economy and Innovation as well as the Ministry of Education and Science.

The university has played an active role in the development of the regional Smart Specialisation Strategy. The University leadership has delegated senior representatives to

the committees called together by the regional government to establish the regional S3 strategy. In order to bring its position to the fore the university has produced a discussion paper in which it outlined its own views on the priorities that the region should adopt. The eventual S3 strategy offered a 60% match with this document in terms of the priority areas selected.

Reflecting the changing regional needs (and student interest), university Alpha has scaled down its department of combustion engine development and automobile manufacturing design. In 2010-2015 5% of its student population follows degrees in these fields, down from 8% in 2005-2010 and 15% in the period 2000-2005. The university's strength in civil engineering lies at the core of the region's strong engineering firms. It maintained its strength by investing heavily in both teaching and research in this field. The region also selected civil engineering as one of its smart specialization areas, in part because of the expected increase in global demand for these competencies and expertise. At present (2010-2015) 18% of its student population follows courses in civil engineering, up from 15% (2005-2010). The region and the country hold a leading position in the field of industrial biotech. University Alpha is one of three national universities offering degree programmes and PhD programmes in this field, which has significantly increased its popularity over time (12% of the student population in 2010-2015 up from 7% in 2005-2010). Its biotech research attracts 40% of its funding from industrial partners, 60% of which originates from a single multinational biotech company located in the Alpha region. At the university business park a cluster of 35 biotech firms has formed. Micro-electronics is another of the S3 priority areas which is partially based on the university's profile and partially on the industrial R&D labs of the three leading manufacturing firms in this field. The firms secure a permanent demand for the university's graduates who are also attracted by competitor firms in other parts of Europe (including the neighboring region Delta in country D). The University actively collaborates with the leading university in the border regions of countries D and E, forming a European technological top region. This network aims at promoting knowledge economy via cross-border cooperation in the broader region.

2. Education and Human capital development

The university's graduates are in high demand both from companies in the region and the country, as well as from firms and research organizations in other parts of Europe and worldwide. 70 % of domestic (non-foreign) students find work in region Alpha. Three years after graduation the employment rate of its alumni is close to 90%. Among those without gainful employment, 85% cite personal considerations or additional studies as a reason. 75% of the employed students has found work in their field of study. A considerable share (17%) also works in other technical fields, especially IT. Engineering students of university Alpha command a considerable wage premium over the country's population with a tertiary education (+700 euro p/m at the time of hiring). However after 10 years the average salary of university Alpha's engineers lags that of medical and business students by 800 euro per month). This wage evolution is similar to the wage evolution of other engineers in the country and, though at different wage levels, the EU.

As a renowned technical university which has co-evolved in partnership with its national and regional industrial base, university Alpha prides itself in its active involvement of industry in the education it provides. Regional and indeed national industry offers a number of grants for top performing students at the university. 65% of students at the university take a traineeship in a company, 35% of which in the region in which the university is located. Regional firms also play an active role in curriculum design, where 5% of the university's credit bearing courses has been designed upon request and with the involvement of non-academic private regional organizations. 10% and 13% of BA and MA theses is written upon request, and with support, of local and regional industry. In order to infuse teaching with practical knowledge from industry the university actively supports its research and teaching staff to spend short spells in industrial labs and allows for industry to support/finance special professorships in which a leading researcher from

industry teaches courses at university. In the period 2010-2015 there were 20 such "industry professors".

University Alpha is one of the largest participants in the national 'industrial PhD' scheme in which PhD students are provided the opportunity to carry out part of their research in a company lab while the company has an active role in setting the research topic and supervising. In the period 2010-2015, University Alpha trained 40 industrial PhDs confirming its national leadership in the programme. In this period the university trained 400 PhD in total, industrial PhD thus made up 10 % of the total.

The university departments and its business school offer curricula with a range of life-long learning possibilities to private sector staff. In 2010-2015 it offered part-time courses worth 600 credits to private sector R&D staff (up from 200 in the period 2005-2010), while hosting 60 (part and full time) MBA students employed and sponsored by the regional industry (up from 35 in 2005-2010). 8% of the university faculty is involved in offering these life-long learning programmes in the period 2010-2015, up from 5% in 2005-2010.

University Alpha offers all its engineering students a compulsory set of entrepreneurship and business courses (100% of the student population follows at least one course on entrepreneurship). Moreover, the business school offers additional teaching and support to technical students who want to embark on a minor in entrepreneurship related disciplines (approximately 10% of the engineering student population). The business school, in collaboration with the university's Technology Transfer Office also offers students with a business idea active support in developing their plans (see also section enterprise development).

3. Research , technological development and knowledge transfer

University Alpha has an increasingly strong position as a global research university, having climbed positions on the Shanghai ARWU ranking of universities (from 60 to 75), the Leiden Ranking (from 72 to 81) and the Times Higher Education Ranking (from 72 to 53) between 2010 and 2015. The university is strong in most engineering and business disciplines but has a particularly strong position in the field of micro-electronics, industrial biotechnology, as well as civil engineering.

University Alpha has established a Technology Transfer Office already in the mid-1980s. As was indicated in section 1, university Alpha's staff succeed in attracting a large degree of private R&D funding. University Alpha's technology transfer office had a total turnover of €240 million euro in 2016, excluding revenues generated from spin-offs. In the same year, it signed 1,200 agreements for services or contract research of which 1,000 were financed by private companies and 200 commissioned by government institutions or in the context of government assignments. University Alpha's technology transfer office (TTO) initiated 125 new patent families in 2016 (see figure below). It received 25 million euro annually from licenses of its existing patent portfolio between 2010 and 2015 – up from an average 20 million between 2005-2010.

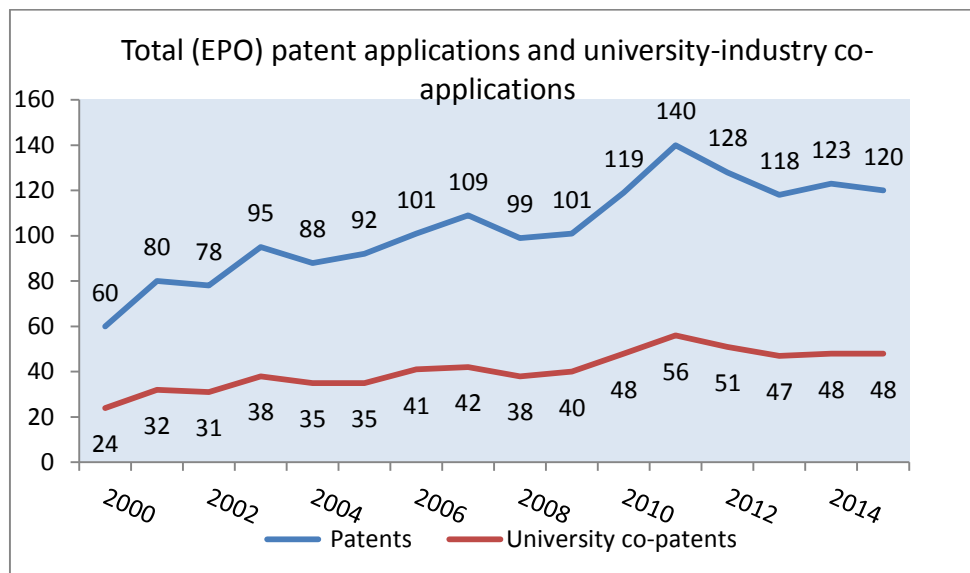
Transferred knowledge as an engine for innovation and growth

Research in the Department of Engineering, made it possible to design a 3D compressor blade as a single component. Blades designed using the research results yielded fuel efficiency improvements of about 1% when deployed in aircraft engines manufactured by a worldwide known company. The efficiency improvements in engines have delivered significant savings in CO₂ emissions and in fuel costs. The demand for this new technology engines increased in recent years. The orders the company received during the assessment period are estimated to be worth more than 20 billion Euros at list prices.

University Alpha attracts 25% of its project research funding from consultancy and contract research for regional industry, approximately 50% from national project funding

and the remaining 25% from foreign sources, including foreign firms (10% points) and European Framework Programme funding. Its strong collaboration with (regional) private partners is reflected in its high rate of public private co-publications (7%). In particular, the partnership with the Japanese firm NewYeast has resulted in the establishment in NewYeast European R&D facilities in the Alpha region in 2013.

Figure 1 Growth of university patterns



As indicated in preceding sections, University Alpha involves regional firms in the development of its teaching and research agenda. The university's Institute of Micro-electronics received a 20 million investment for the establishment of a new research institute from a multinational corporation operating in the region in 2014. Shared R&D facilities have also been established between the university and the regional leading biotech firms. Some of those facilities are now also open to other small and medium sized that formed the biotech cluster set up around University Alpha. In addition to strategic partnerships with firms, the university engages intensively with the two national research institutes and the university of applied science that is active in the region.

Between 2010 and 2015 5% of university faculty and 20% of postdocs and PhD researchers took up positions in regional business enterprises. The university believes this form of knowledge transfer "wrapped up in a person" to be among the most successful ways of transferring the knowledge and skills it generates through its research. Likewise the university also hosts 20 special guest professors from industry. In addition, the large micro-electronic company (MEC) has established a bi-annual prize for the student with the most innovative business idea; the prize involves a sum of money as well as active support from the TTO to commercialize this idea.

4. Enterprise development and entrepreneurship

Besides contract research, University Alpha's TTO has generated a portfolio of 120 spin-offs, of which 95 are still active, directly employing more than 4,000 people. University Alpha's spin-off companies raised € 600 million of capital over the last twelve years, which has resulted in a stronger regional high-tech economy. The university is actively involved in the provision of seed capital for spin-off firms through a dedicated fund it operates jointly with the regional government and two banks. This seed capital funds has so far invested 30 million euro in 35 spin-off firms. 3 firms have made an IPO between 2010 and 2015. The number of spin-offs has increased steadily during the last 20 years (see Figure 2).

The TTO has played an essential role in the realization of a new science park. University Alpha has invested substantially in its own science parks and related infrastructure (business centers, incubators and accelerators) since the mid-1990s. At present it hosts 7 joint research centres, 2 technology clusters, 4 science parks and 2 incubators. The National research institutes and the region Alpha's university of applied science are associated with one of these science parks.

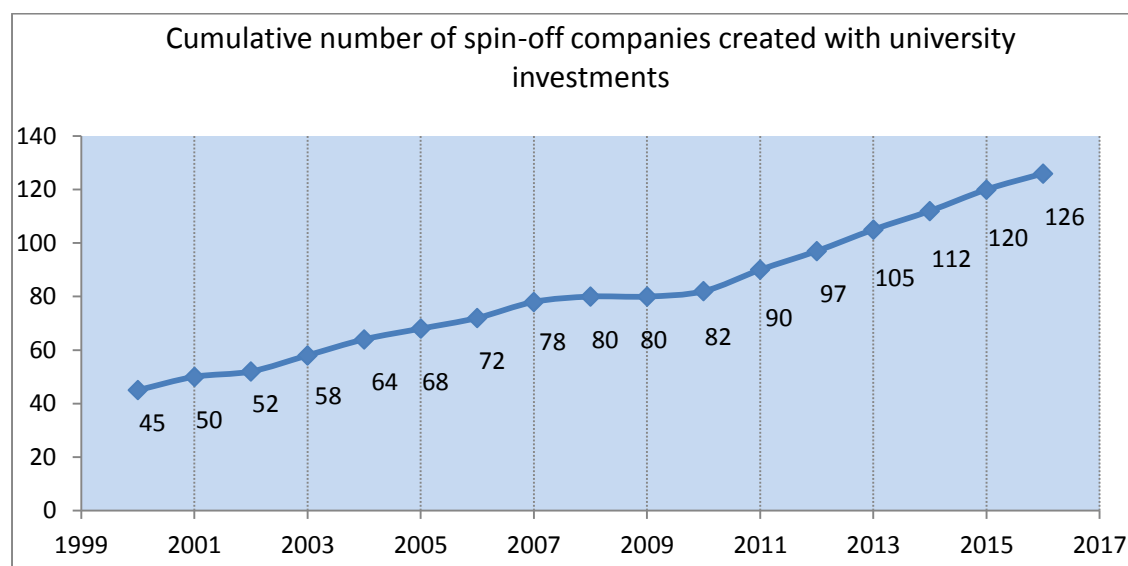
Spin-off companies can find accommodation in the Alpha Innovation & Incubation Centre (AI&IC), the bio-incubator and the science parks in Alpha's high-tech region. AI&IC is managed by Alpha University, the city of AA and a number of private companies. It offers infrastructure, equipment and services to new research-oriented, innovative businesses. Besides this, the science parks of Alpha University have taken the shape of a real 'technology ring', where dozens of high-tech businesses - both spin-off companies and major international companies - are based.

Through ACT-E (Alpha Community of Technological Entrepreneurship) students of the university are given a say in the development of the university's innovation related activities (including the science parks and incubators). The university strongly believes in promoting the bottom up dynamics which a vibrant community of student entrepreneurs brings to the ecosystem. Students and alumni have been involved in the set up of 40 new firms in the period 2010-2015, 20 of which survive to the present day where one has grown into a large high-growth innovative enterprise employing already 800 employees (see box) with an annual turnover of 50 million euro.

Fuel cell spin-out success

*Joint research in the Departments of Chemistry and Engineering at University Alpha has led to the development of a new generation of clean power systems based on advanced fuel cell technology. This resulted in **the creation of a spinout company** in 2007. Ten years later, the company has a global presence: a workforce of over 500 highly skilled employees, significantly advanced technology, investments in R&D and was valued at \$0.8B in 2015. It is still located in the region Alpha and its CEO is member of the university board.*

Figure 2: Growth of number of university spin-off companies



5. Vision and strategy for the near future

Having set up the necessary infrastructure, mechanisms and networks - and having achieved a high level of respect and credibility among students, peers, public authorities and private sector stakeholders, at regional, national and international level - it is time for university Alpha to move forward and invest in scaling up its innovation impact.

The university's most recent 'Strategic Plan 2016-2020' states: "... aims to become a global innovation leader by 2020, delivering world class solutions and providing a greater contribution to the economic growth of its region".

The strategy to achieve this aim is to connect disciplines and departments in joint research projects, increase the number of courses developed jointly with regional industry, invest in new collaborations with the private sector, provide access to finance for innovative companies to scale up and contribute to the internationalisation of regional R&I networks.

Annex 4b Case study of "University Beta"

Comprehensive research-intensive university in a European capital city

Introduction of the university in its regional context

University Beta is country B's leading comprehensive university. It is also the country's oldest university, with a proud history going back three centuries. The university covers most traditional scientific disciplines, including the natural sciences, social sciences and humanities, as well as the country's leading medical school. The university has trained most of the country's leading lawyers, politicians, civil servants, business leaders and medical doctors. Country B is classified as a 'moderate innovator' and this is also the classification of the capital region Beta, home to University Beta. Apart from University Beta, this capital region hosts two universities of applied science, a technical university and 6 of country B's National Research Institutes (NRIs).

University Beta ranks among the world's 500 leading universities in several of the major university rankings (THES, Leiden Ranking, Shanghai ARWU ranking), and is top 100 in selected fields like immunology, sociology, film studies, Slavic studies and several other arts and humanities disciplines. The university has co-evolved with its metropole and local region, which is characterized by a strong generic drug, biotech, film, publishing and banking sector. The region used to be a thriving textile and petrochemical sector, but over the past 30 years most traditional manufacturing has moved to other parts of the country or abroad.

The university has strong ties with the (often foreign owned) banks in the capital. Around the university and building on the remains of the large pharmaceutical firm, that went bankrupt in the early 2000s, a cluster of generic drug manufacturers and medical biotech firms has formed in and around the university and the capital city. The generic drug manufacturers are highly successful, catering for the whole EU market and beyond. Also a number of the medical biotech firms are highly promising. Several have attracted substantial FDI in recent years. Two of the most successful biotech firms have decided to move to the USA leaving moderately sized R&D facilities in region Beta.

The university has retained its long tradition of faculty-elected leadership. This collegial model is also reflected in the relative independence of the different faculties of the university. Several of these faculties have become fairly entrepreneurial in their own right. For example the faculty of biosciences has played a large role in the development of the biotech cluster. The faculty of arts, which includes the school of visual arts and film, was at the basis of the fledgling film and animation industry in region B.

The contributions of university Beta to its regional innovation ecosystem are outlined in the following four subsections of this annex, which are classified according to the four impact categories presented and discussed in the report and its annex 1.

University Beta: key facts and figures

	2005	2015
Budget	130 million euro	150 million euro
# staff (FTE)	3000	3300
# of research staff (FTE)	1500	1600
# students	40,000	42,000
# publications	10,000	13,000
% top 10% publications	12	14

1. Regional orientation, strategic development and knowledge infrastructure

University Beta is a national university which attracts students from all over the country B. The national government is its main source of funding. However in its mission statements and its marketing activities, it strongly identifies with the capital region that shares its name. While it emphasizes its national role, it refers to the role it plays in the regional innovation ecosystem in terms of human capital development and having supported the nascent biotech cluster. The university leadership actively cultivates links with management and human resource departments of the large and medium-sized firms in the region. It does the same with the national and regional administrations, public and semi-public bodies. It has established a board through which the representatives of the major businesses in the city can advise it on strategy development.

The university has taken an active role in attempts to regenerate the regional economy after the rapid decline of manufacturing and later the bankruptcy of its large pharmaceutical firm. Together with local business leaders (including the banks and publishing industry), the national, regional and city government, it developed an action plan to stimulate the development and support of the biotech and film clusters. The respective faculties/schools actively contributed to in the implementation of these plans and most occurred through bottom-up development. The school's leadership successfully lobbied for both a national and regional innovation fund to support these development. In 2012, this lobby also resulted in the launch of a public-private venture capital instrument to support the further growth of these firms. The structural funds are an important source of R&I funding for country B where university Beta has, from the outset, played an active role in the development of the region's Smart Specialisation strategy. University representatives, especially those from the faculties for bioscience, medicine and arts, have actively lobbied for the prominent role that biotechnology and the creative industries occupy in the region's S3 strategy, alongside the publishing and financial services sectors.

While University Beta attracts high quality students from around the country, still 65 % of its student population originates from the capital region Beta. The university identifies itself with the capital city, which is traditionally also the place where most of its alumni find work in either the public or private sector. Over the past decade the regional government increasingly sees the presence of University Beta as a valuable asset - not only for the prestige it brings, but also for the contribution it can provide to the region's economic development. To this end the regional innovation agency, which was set up in 2006, uses 65% of its 20 million euro annual budget to fund projects and activities that are either coordinated by staff of university Beta or are closely associated with this university (e.g. in terms of start ups established by the university's alumni). University Beta does not have a major engineering faculty, as this faculty established its own university 150 years ago, but maintains close ties to this university and to the NRIs in the capital. In fact, in 2008, the former NRI Institute of Biosciences was turned into a joint institute between University Beta and the National Research Institute. The local biotech and generic drug industry recruit most of their biomedical R&D staff from the bioscience and medical faculty of university Beta. They work together with the process engineers trained in the technical university located in the capital city.

The region and the country thus have an emerging position in the field of medical biotech. University Beta is the only national university offering degree programmes and PhD programmes in both basic and applied biosciences and medicine. These three studies combined have significantly increased their popularity over time (25% of the student population in 2010-2015 up from 20% in 2005-2010). Its biotech research attracts 45% of its funding from industrial partners, 80% of which originates from the medical biotech and generic drug firms in the biotech cluster in the Beta region. This cluster has formed around the university business park which hosts 25 medical biotech firms.

The University generated 15% of the R&D funding through contracts with regional firms in 2010-2015. This marks an increase from the preceding 5 year period when it was 10%. Almost two-thirds (63%) of this private R&D project funding is accounted for by

the bioscience and medical faculties. While in the life sciences the rate of co-publications with regional industry is relatively high at 10%, this is not yet the case for the university as a whole. While in the natural sciences, and more so in the social sciences and humanities, it is less common to co-publish with industrial partners this does not mean there is no engagement with the corporate sector. In fact, many of the university's alumni in the social sciences and humanities (SSH) tend to find work in the banking and publishing industry in the capital. These business enterprises work together with the SSH faculties to inform curriculum design and applied research projects. Over the past 10 years the nascent film and animation industry has grown into one of the leading centres of avant-garde (especially animation) cinematography in the continent. Producing films not only for the domestic market but increasingly for international audiences, this industry employed an estimated 1 500 alumni from university Beta's famous art school in 2015. The faculty of this particular school have close ties to both the larger and smaller studios, all but one are led by university Beta's alumni. The university is heavily involved in the organization of a major international film festival in the capital region. This festival benefits from VIP participants, from all over the world, presenting their latest artistic products. Attracting extensive coverage by the national and international media, this festival significantly contributes to the regional economy in part because of the number of tourists it attracts.

The collaborative ties of the university with foreign centres of research excellence, plays a role in the internationalization of the region as well. Its researchers co-publish with researchers in over 60 countries and 24% of its publications was made with foreign counterparts in 2015 (up from 18% in 2010). University Beta is not only a member of the EUA but has also formed a collaborative network with the leading research university's in the capitals of Country B's neighboring countries to support the further development of research universities in this emerging European region.

2. Education and Human capital development

The quality level of the education is rated highly by both domestic and foreign partners. University Beta traditionally supplies graduates to Country's B largest companies, many of which are headquartered in region Beta. Forty percent of national civil servants and 25% of medical doctors also graduate from this university. 65% of the domestic (non-foreign) students find work in region Beta. University Beta graduates also go to other parts of Europe (as well as the USA; a small minority goes to Eastern Asia and elsewhere). Three years after graduation the share of alumni without fixed employment sits at 8%, well below the national average. Among those without paid work, 60% respond "further study" or personal factors as motivations. Around 50% of the graduates find work in a field that is closely related to their field of study. Another 30% indicate that they do make frequent use of the knowledge acquired at University Beta.

Several faculties of university Beta (arts and biosciences in particular) have sought to involve private sector firm in the design of their study curriculum. In total 3,5 % of the university's credit bearing courses is designed upon request, and in close collaboration with, private regional stakeholders. Some 40% of the Master students of university Beta take up an internship, 50% of them in a regional firm. 18% and 15% of BA and MA theses is written upon request, and with support, of local private or public actors. In order to infuse teaching and training with practical knowledge from the business sector, the university actively encourages the interaction of its faculty with local firms. Since 2010 the country's performance based funding system includes an assessment of the university's collaboration and interaction with industry.. The university has an internal incentive system which allocates part of this money to individual departments or researchers in the university. Occasionally, firm representatives visit the university to provide lectures on, for example, new developments in the film industry or immunology in the faculties of arts and biosciences respectively. This happens on average once a month across the university.

University Beta is a centre of excellence in Slavic studies. The university attracts students from all over Europe. In 2005, the language faculty and the business school have set up a joint degree programme in 'Russian studies' in which students combine the learning of the Russian language with subjects on Russia business and economics. This study has been very successful in attracting bachelor students. Virtually all of the programme's alumni find suitable employment which increases its appeal. The University in collaboration with a bank which has a major operation in the Capital region, has also established the 'Beta Fellowship' programme, where junior executive and opinion makers from business, public media and politics are selected to spend a period of six months in an intensive language and culture programme at university Beta and six months in a company (including newspapers) or public administration in Russia. The programme is very successful and raised the profile of the university across Europe and especially in Russia. Some of the alumni have ended up working in the banks and publishing firms in the Capital region of country B.

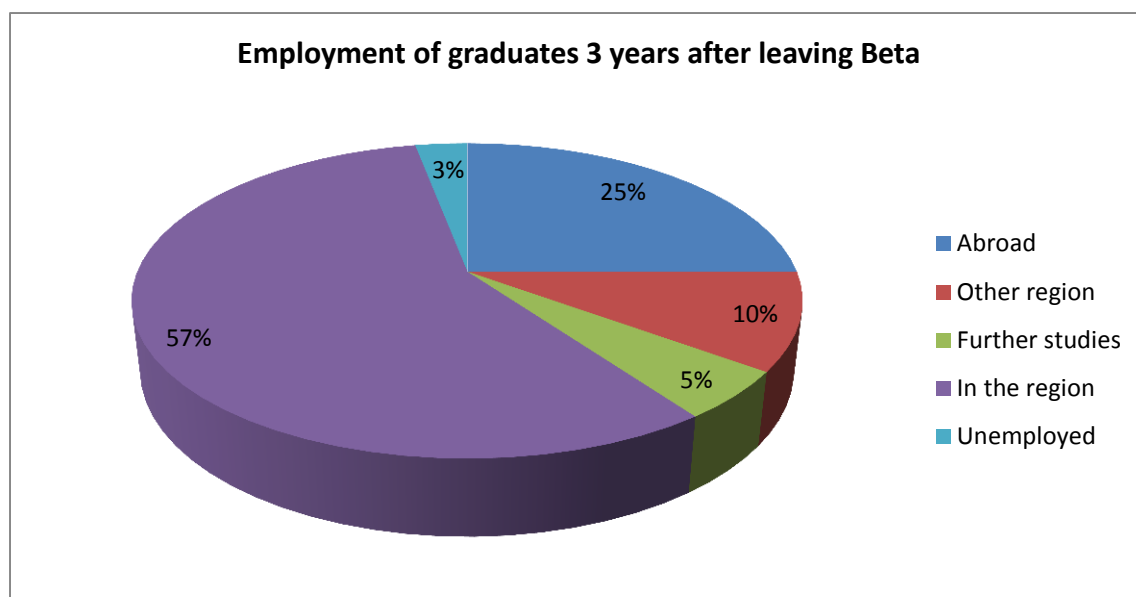
Russian studies alumni Consultancy

In 2008 alumni of the course have set up a consultancy firm to advise European businesses to operate in Russia. This firm has grown till 150 employees since then and provides services to clients throughout Europe. The firm works closely together in R&D projects together with the business school in the form of contract research. The firm also hosts up to 15 trainees from the university annually. The consultancy firm does not only cater for European clients but also advises Russian firms which want to invest in Europe. In 2013, the Russian logistics firm Vlodstock has set up its European headquarters close to University Beta's business school. This involved an initial investment of 20 million euro which may increase in the future.

In the 2010 coalition agreement, the government has asked Country B's universities to develop life-long learning programmes to overcome structural unemployment and help the country's transition from a manufacturing economy to a more knowledge-intensive economy. University Beta has heeded this call and several of its departments as well as the business school now offer life-long learning opportunities for public and private sector employees. Around 20% of the staff is in some way involved in these programmes. In the period 2010-2015 the university provided around 500 credits in training to public and private sector staff (up from 50 in 2005/2010). The business school trainees 150 MBAs annually, 50 of these degrees were granted to management staff from local firms in 2015, up from 20 in 2010. In collaboration with the business school the faculty of biosciences offers its students the option to do a set of entrepreneurship courses (approximately 40% of its students follow at least one course on entrepreneurship). This set of courses can be extended into a minor, which is followed by 10 students annually.

Since 2005, around 25% of University Beta's students leave the country after their studies to find work abroad. While the region sees this as a loss of human capital to the regional economy, it also realizes that not all these alumni might have been employed quickly (unemployment of university trained 25-35 -year-olds is around 12%). Studies of the university's (well kept) alumni database indicates that several of these alumni play an important role in embedding the university, and the region, in international R&D networks. Though difficult to quantify, it also appears as if some of the recent foreign direct investments in the capital region (especially in the publishing industry) can be linked to the university's alumni. Many return to region B after a successful stint abroad. In fact three out of the four CEOs of the largest firms in the region are university Beta alumni with substantial foreign work experience. Over the past year, 85% of the new recruitments in university Beta concerned either foreigners or B-nationals with foreign work experience. The university has set up an alumni network to maintain in contact with its alumni abroad. Apart from outbound migration the university also attracts students and researchers. Those students come especially from the broader region and neighboring countries, where university Beta is seen as very prestigious. Another source of students is Russia, where the university traditionally has important links with several

large universities. At present 10% of its master students and 30% of its PhD and postdoc population have a foreign nationality.



3. Research, technological development and knowledge transfer

University Beta is among the top 100 universities in the field of immunology, film studies and sociology according to the THES Ranking or Leiden Ranking of universities worldwide. As a whole the university ranks among the top 500 in all major world university ranking systems.

In 1998 the university established its Technology transfer office – 'University Beta TTO'. This TTO offers support to university staff in attracting private funding and dealing with contractual issues. The university is also responsible for managing University Beta's IP portfolio. University Beta's TTO generated a total turnover of 20 million euro in 2015. In the same year it announced that 200 new contracts were signed, involving 300 FTE – of which 50% scientific staff and 25 % PhD researchers. The TTO filed 20 new national patent applications and four applications to the European Patent Office in 2015. It received 1.5 million euro annually from licenses from its existing patent portfolio in the period 2010-2015 (mainly due to two medical biotech related patents that are used by firms in the regional biotech cluster).

Film and animation

The arts school in collaboration with the audiovisual technology group in the technical university in the region has developed a new approach to developing (clay) animation pictures in 2005. These new techniques have revolutionized the way animation pictures are made within the film cluster (and indeed worldwide). This formed the basis for the growth of an incumbent and a new film studio. Universal Animation, a leading US firm, has recently acquired the rights to 20 films for the US market for a sum of 25 million euro. The regional film cluster employs many University Beta Alumni and attracts talent from across Europe. Currently its firms employ close to 3000 people.

The University Hospital was established alongside the medical school in 1850. At present the hospital is used for the training of medical graduates. It also plays an important role, together with a local clinical contract organization, in the running of clinical trials for novel drugs and medical treatments for two European and multinational pharmaceutical companies. Research at the medical and bioscience faculty has been transferred to the biomedical companies in the region and beyond. Several patents have been granted based on the research carried out in the past 10 years.

Apart from the biotech cluster, University Beta's arts school is strongly involved in the emerging film industry cluster in the capital region. Most of this involvement takes the form of faculty being involved in drafting screen plays, close links between the art school and film companies in the development of the curriculum and dual appointments (three visiting professorships). There is also technology transfer based on a research programme which the art school is developing jointly with the technical university in the capital region (see Box on previous page).

University Beta attracts 15% of its project research funding from consultancy and contract research for the regional industry, approximately 70% from national sources, and 15% from foreign sources. Funding from abroad includes funding from foreign firms (3%), the EU structural funds (8%) and European FP funding (4%).

University Beta allows regional firms (especially the biotech start-ups) to make use of its R&D facilities and infrastructure. It generates some funding from this source, though its main objective is to support the further development of regional R&D capacities.

Between 2010 and 2015, some 50 members of university faculty and 200 postdocs and PhD graduates started working in regional firms: especially in the publishing industry, finance (graduates from both economics, finance as well as the natural sciences) and the biotech industry.

4. Enterprise development and entrepreneurship

As part of the regional rejuvenation strategy, university beta and the University Beta TTO have actively supported the development of alumni-generated university spin-off firms and university related start-ups. In 2015 the Beta TTO had supported up to 40 new firms, 34 of which are still active, directly employing some 1000 people. Not all these firms are 'high-tech'. University Beta's spin-off companies raised € 25 million of capital over the last ten years, which has resulted in a stronger regional high-tech economy. The public-private venture capital funds and seed funds, which the university has initiated together with local banks and financiers, have helped already three firms to grow into internationally active players. This fund has so far invested 4 million euro in five spin-offs. Over the past 15 years the number of spin-off firms has increased steadily, with a dip between 2008 and 2013 from which the region has recovered since then.

The Beta TTO has played an important role in establishing a science park, together with the bioscience and medical faculty of university Beta. Around this science park the region's biotech cluster is being formed. Since 2012 the TTO also runs an incubator for the development of new promising firms. It does so jointly with the municipal government of the Capital region. It offers infrastructure, equipment and services to new research-oriented, innovative businesses.

The university's arts and business schools have actively supported the development of the film and animation firms in the capital region. They are not only a source of new staff and actors for these firms, but also actively provide new ideas and technologies. In addition to the incumbent film studio, three new studios have been formed. Two of these were set up by university Beta alumni and one by a former university Beta staff member. The two studios set up by Beta alumni have grown rapidly, supported by the regional innovation funds, favorable bank loans, an investment from the public private venture capital fund and a licensing deal

Betaimmun

The University Beta spin-out company Betaimmun is developing novel immunotherapies for the treatment of cancer. Findings of the research initiated at Beta's labs led to significant changes in clinical practice and improved patient outcomes. Betaimmun by licensing products and raising money on the stock exchange, it has provided an excellent return for investors, reaching a market capitalization of 20 million euro in 2015. This has encouraged further investment which is in line with the national and regional plan to promote the Biotechnology Industry. As the products progress to market it will save further lives and continue to increase in value providing further profit for investors.

with a foreign investor. At present these firms jointly employ over 700 people in 2015, up from 50 and 200 in 2005 and 2010 respectively.

5. Vision for the near future

University Beta's Strategic Planning document is explicit in its aims for the near future:

- capitalize on its existing strengths in the life sciences, arts and Slavic studies to support its educational profile but also promote a greater engagement with local firms and support enterprise development with its public and private sector partners.
- build on the remarkable impact of Beta TTO, expand its activities and portfolio in order to ensure that the university can better realise its innovation potential on the regional economy.
- continue to argue that the creative industries and biosciences should be at the heart of the region's Smart Specialisation Strategy, alongside publishing and financial services.
- further capitalize on its strong international position in Russian studies to attract more Russian firms to Beta region, as their gateway to Western Europe, while performing a similar function for European firms seeking to expand in Russia.
- seek to further engage with its large number of foreign-based alumni to strengthen the international networks of the university while contributing to the internationalisation of regional R&I networks.

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