EUA PUBLICATIONS 2014

UNIVERSITY-BUSINESS COLLABORATIVE RESEARCH: GOALS, OUTCOMES AND NEW ASSESSMENT TOOLS

THE EUIMA COLLABORATIVE RESEARCH PROJECT REPORT

Lidia Borrell-Damian, Rita Morais and John H. Smith

EUA
European University Association

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Lidia Borrell-Damian,[1] Rita Morais[2] and John H. Smith[3]

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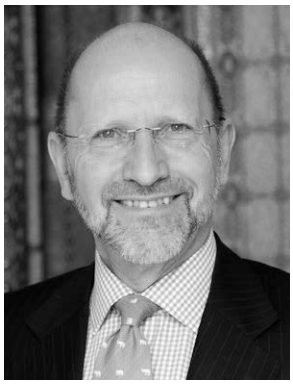
This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 250442.

This report is part of a series of EUA publications on the outcomes of the EUIMA project. Additional outcomes of this project include the Assessment Tool for University-Business Research Partnerships (U-B Tool – online self-assessment tool) and two EUA project papers by EUIMA senior advisers Dr David Livesey and Mr Stephen Trueman.

All materials can be found at www.eua.be

FOREWORD



I have always seen as a high priority that we should foster and maintain a productive dialogue with all partners involved with universities in furthering their research and innovation activities. We have engaged crucially with the European Commission over the future development of the Horizon 2020 programme, particularly the European Research Council and the European Institute of Innovation and Technology, and with the national research funding bodies and their European representative bodies.

But, most importantly, through the RPWG's work we have placed strong emphasis on the importance of university partnerships with industry and business, and with public authorities and agencies. This has been reflected in the creation of the "Responsible Partnering Guidelines" (developed by EUA with industry and research and technology organisation European partners), the new partnership with the Joint Research Centre on the implementation of Smart Specialisation Strategies, our work on collaborative doctoral research and the recent EUIMA project to which this new report is addressed.

Universities have a tendency to be modest about the extent of their research collaboration with external partners and its achievements. Too much of the narrative on university-business collaboration is led by others, usually writing negatively in the media who characterise university-business collaboration as virtually non-existent or poles apart in attitudes and motivations. With this report, EUA seeks to restore some balance and let the evidence speak for itself on the good practices achieved by research practitioners, and the challenges faced and tackled.

Today, industry and businesses need interdisciplinary research approaches to societal challenges such as energy, climate change, food and water supply – which are key to new markets for products and services. Universities are the main source for new knowledge, innovative thinking and skill development on such societal needs. Industry knows this and universities in turn know that the prime concern of industry and business focuses on commercial application. Aligning interests – mutual interests and shared experience – is the challenge, as is maintaining the independence of fundamental science and new knowledge creation which is, in fact, equally highly valued by both sides of the partnerships.

Universities are central to the research and innovation "eco-system" and industry and business recognise the high value of this local proximity of expertise. Increasingly too the partner universities' research networks with their international links are privileged pools for the "people-sourcing" that industry and businesses conduct on a local and global basis.

"Smart People for Smart Growth" was EUA's message in its position on the launch of the new "EU Innovation Union" initiative within the Europe 2020 Strategy, and it remains so today. It stated that "Innovation is, at its roots, all about people and their ability to reach their full potential in skill development and resourcefulness, and fostering the right conditions to achieve and maintain it". With this EUIMA report, EUA demonstrates that the right conditions for fruitful university-business partnerships can be achieved across Europe and points to the lessons learnt and the ways and means for their future progress and sustainability.

Professor David Drewry
EUA Vice-President and Chair of its Research Policy Working Group

EXECUTIVE SUMMARY

University-Business research collaboration has been the subject and focus of attention for many years on several levels: at the level of universities themselves with the development of the so-called "third mission" of universities; at the policy level through new initiatives; at regional, national and European level to foster innovation and job creation through research and training; and last but not least, in the political discourse and debate on how to improve European competitiveness in the global economy – a debate that has been accentuated by the recent financial and economic crisis and how Europe can exit from it in an improved position.

Behind the political discourse and debate has rested an assumption that Europe's universities need to do more to engage with business to achieve the creation of innovative products and services from their universally recognised high-quality research activities – in order to overcome the commonly described "European paradox" in comparison to other regions of the world. However, future policies arising from such debates need to benefit more from fuller empirical knowledge and understanding of the current nature of university-business collaboration, how it is initiated, undertaken and assessed by the actors themselves – the university and business partners. This was the principal aim and objective of the EUIMA Collaborative Research project – to bring further empirical evidence to the debate on how to strengthen university-business collaboration through the promotion of successful good practice, with a view to contributing towards the future development of a wider range of assessment tools and performance indicators and appropriate supporting instruments and incentive mechanisms.

The EUIMA Collaborative Research project used two complementary approaches to collect data on university-business cooperation – in-depth case studies through questionnaires and workshops. The project aimed at identifying main trends and cross-cutting issues in the long-term collaborative research projects/initiatives presented by universities and their external partners. This report shares good practices that have been learnt through their experience in developing university-business collaborations, and considers aspects that could be potentially applicable to a wider group of university-business collaborative research initiatives.

The project's main conclusions highlight some of the most important aspects in developing successful university-business partnerships: fostering the strategic mission of universities; providing a closer connection between education, research and innovation; adapting to the evolving needs of the labour market; improving the quality of human resources and ensuring the existence of support structures to effectively promote the flow of knowledge transfer from the university to companies, regions and society at large. Finally, a key major outcome of the EUIMA project is the new *Assessment Tool for University-Business Research Partnerships (U-B Tool),* which offers a broader range of indicators to assess collaborative research partnerships, namely those focusing on the quality of the collaboration process. The use of these indicators, together with the more traditional quantitative indicators, allows for a more comprehensive view of the manifold outcomes and factors that come into play in university-business research collaborations.

1. DEVELOPMENT OF THE EUIMA-COLLABORATIVE RESEARCH PROJECT: CONCEPT AND METHODOLOGY

1.1 INTRODUCTION AND CONTEXT

University-Business research collaboration has been a subject of debate for several years, on the key issue of how to improve regional and national economic development and, indeed, European competitiveness in the global economy – a debate that has been accentuated by the impact of the recent financial and economic crisis.

Over the years the fostering and enhancement of university-business collaboration has involved the establishment of many new facilities such as "technology transfer offices" and "research and development units" within universities themselves. These new facilities have been often encouraged and supported by regional and national policy initiatives. But also governments, particularly at the regional level, have taken many initiatives to establish "intermediary bodies" to act as a catalyst between universities and businesses to incentivise their collaboration. The initiative of the European Institute of Technology (EIT) promoted by the European Commission has been the most manifest example of such an initiative at the European level. Furthermore, the new emphasis placed on the concept of an "Innovation Union" within the "Europe 2020 Strategy" and its strong linkage established between research and innovation has been reflected in the design of the new European Commission Research Framework Programme "Horizon 2020" which has the EIT initiative fully integrated within it.

Underlying the political discourse and debate behind these policy initiatives has rested the assumption that Europe's universities need to do more to engage with business to achieve the creation of innovative products and services from their universally recognised high-quality research activities – in order to overcome the commonly described "European paradox" in comparison to other regions of the world. However, future policies arising from such debates need to benefit more from fuller empirical knowledge and understanding of the current nature of university-business collaboration, how it is initiated, undertaken and assessed by the actors themselves – the university and business partners. This was the principal aim and objective of the EUIMA Collaborative Research project – to bring further empirical evidence to the debate on how to strengthen university-business collaboration through the promotion of successful good practice, with a view to contributing towards the future development of a wider range of assessment tools and performance indicators and appropriate supporting instruments and incentive mechanisms.

The EUIMA project, which stood for "Europe's Universities Implementing their Modernisation Agenda", was a coordination and support action funded by the European Commission under the 7th Research Framework Programme. The project addressed two major elements of the modernisation agenda for

European Universities: i) the strengthening of university-based collaborative research and its assessment tools reflecting the diversity of university missions (EUIMA Collaborative Research); ii) the sustainability of university funding, financial management and development of full costing (EUIMA Full Costing). A third transversal focus running through the project aimed at identifying requirements for further development of human resources and management in universities in these domains. EUIMA project activities (2010-2012) ran in parallel with major stages of the development of the new European Commission's research and innovation and education programmes (Horizon 2020 and Erasmus+) to operate from 2014 to 2020. Empirical evidence from the project was brought forward in different stages through the various stakeholder consultations to inform the policy development process.

Important contributions were made towards the debate and development of the Green Paper on "The European Research Area: New Perspectives", the EC Recommendation on "The Management of Intellectual Property in Knowledge Transfer Activities for Universities and Other Public Research Organizations" and the EC Communication on "Better Careers and More Mobility: A European Partnership for Researchers". Furthermore, the outcomes of the project were fed into policy processes at European level through official EUA statements such as: the EUA position on the EC "Green Paper" on a Common Strategic Framework for EU Research and Innovation Funding (2011); the EUA position "Smart People for Smart Growth" on the EU flagship initiative "Innovation Union" (2011); the EUA response to the consultation of the European Commission on the Modernisation of Higher Education in Europe (2011) and the EUA Input to the Debate on the Rules for Participation in Horizon 2020 (2012).

EUIMA Collaborative Research activities built upon experience from previous and current EUA work examining relationships between universities and industry developing collaborative doctoral education and the professional insertion of doctorate holders (DOC-CAREERS & DOC-CAREERS II), as well as the exchange of best practice in collaborative research through the "Responsible Partnering Guidelines Initiative". The project aimed also to take up the results and recommendations arising from the European Commission Expert Group on the Assessment of University-Based Research. From the terms of reference of the Expert Group and its report, a main issue of concern was to develop a "multi-dimensional tool" for the assessment of university-based research which would take account of present assessment tools, their strengths and weaknesses, and of the diverse research missions and contexts of Europe's universities.

The project started, therefore, on the following premises: a new multi-dimensional assessment tool was foreseen to be required for the following reasons.

(i) The debate on the assessment of performance of university-based research has tended to be dominated by reference to assessment tools that are focused on measuring output from universities in terms of scientific publication citation, Nobel Prize and other high-achievement scientific awards.

(ii) These tools are designed essentially for measurement of high performance in fundamental research in research-intensive universities. But given the public and political attention that they have commanded, all universities are being measured increasingly by them whether or not they are appropriate for the measurement of the achievement of excellence in the research missions of universities, beyond their contribution to highly cited fundamental research.

(iii) The definition of "excellence" in university research has tended as a result to be confined to this paradigm, whereas excellence in research can demonstrate itself clearly also in other research missions, in particular in collaborative research with external partners.

(iv) Furthermore, where "ranking exercise" outcomes based upon traditional assessment tools become highly influential in resource allocation to universities, they can take on a consequential dimension not foreseen or intended by the ranking methodology, which can be potentially detrimental to the further development of the wider missions of universities.

The project concentrated on collaborative research between universities and external partners from industry, enterprises and regional authorities. In particular, the focus was on assessment tools which go beyond the traditional and widely used quantitative measurement indicators, towards better ways of measuring the more intangible aspects of research collaborations. The outcome of this approach sought to be a more comprehensive way of assessing university-business/enterprise cooperation, complementing quantitative outcomes with qualitative or semi-quantitative measurement tools.

The EUIMA project benefitted greatly from cooperation with the European Industrial Research Management Association (EIRMA) who offered advice on case studies and helped to facilitate access to business partners through interviews or their contributions to workshops. Hence, each project activity entailed extensive prior contact and consultation not only with each university but also with their industry/business partners. This impact can be measured in the high percentage involvement of industry and business partners in EUIMA activities, and the unique character of EUIMA workshops of always ensuring "double-act" contributions from university and business partners on their research collaboration, and their engagement in the debate for the whole duration of the workshops.

Building trusting relationships and open dialogue between universities and industry/business partners is the "sine qua non" of successful collaboration, and it has been instrumental in developing the wider range of indicators for the assessment of collaborative research in this project. EUIMA activities held across Europe have also demonstrated clearly the key role of collaborative research and innovation activities involving university and business partners (particularly SMEs) in helping to facilitate the economic and social development at the regional level. Project findings, by demonstrating the importance of place and location and in avoiding "one-size-fits-all" approaches but identifying some common elements and indicators of successful research and innovation activities, can valuably inform future investment of public funds for regional economic and social development.

Consequently, the EUIMA Collaborative Research project results will have a lasting impact through EUA's continuing work, *inter alia,* on revising and updating the "Responsible Partnering Guidelines Initiative" with EIRMA and the European Association of Research and Technology Organisations (EARTO), and in promoting the need for an enhanced role of universities in the design and implementation of the new "Smart Specialisation Strategies" within the European Union Structural and Investment Funds.

1.2 APPROACH AND METHODOLOGY[4]

The EUIMA Collaborative Research project used two complementary approaches to collect data on university-business cooperation – in-depth case studies through questionnaires and workshops. Whereas the in-depth case studies allowed the collection of a substantial amount of information in a structured way, the workshop format focused to a greater extent on discussions among participants from universities and external partners on a variety of topics, namely good practices in collaborative research and assessment of the collaboration process and outcomes. These two methodological approaches – case studies and workshops – provided a rich volume of information on the experience of several universities and external partners involved in collaborative research. In addition, the case studies and workshops were developed and organised hand in hand: presentations in workshops were based on case studies, and the case studies presented in a particular workshop were selected taking into account the theme of each workshop and its sessions. The articulation between workshops and case studies is illustrated in Figure 1.

[4] A more detailed explanation of the methodology used in the EUIMA project is presented in Annex 1.

Figure 1: Articulation between EUIMA Collaborative Research Case Studies and Workshops

Source: EUIMA Collaborative Research project

The selection of university-business collaborative research initiatives to be included in the EUIMA project took into consideration several criteria, namely:

- the aim of the collaboration was fostering regional or national development, scientific or technological leadership in a specific field or strengthening the economy;
- the collaboration between the university and company or cluster had been ongoing for at least five years;
- the partnership was seen as a long-term initiative and as a process that built on mutual trust and achievements, with assessment tools that had been evolving along the life-time of the initiative;
- the case studies presented examples from different industrial sectors in different fields of knowledge: Science, Engineering and Technology (SET), Biotechnology, Medical and Life Sciences (BML) and Economic, Social Sciences and Humanities (ESSH).

During the EUIMA Collaborative Research project, five workshops were organised:

- **Workshop 1 – Leuphana University**, Germany: 5-6 October 2010
- **Workshop 2 – Tampere University of Technology**, Finland: 22-23 February 2011
- **Workshop 3 – Karlstad University**, Sweden: 12-13 May 2011
- **Workshop 4 – Politecnico di Torino**, Italy: 8-9 November 2011
- **Workshop 5 – University of Cambridge**, United Kingdom: 5-6 December 2011

In addition, 19 in-depth case studies, in the form of a questionnaire, were provided by 16 universities in 12 European countries (for the complete list of participants in the EUIMA Collaborative Research project, see Annex 1). The questionnaires were addressed to universities involved in collaborative research activities and aimed at providing an in-depth view of the collaborative research project. The questionnaire was organised in two broad parts: in the first part, information was sought on the institutional context and general framework of the collaborative research initiative. This covered aspects such as the socio-economic characterisation of the region, the relationship between the university and its external partners

and the motivations, outcomes and challenges of the collaboration. In this part of the questionnaire, universities were invited to provide their views in response to open-ended questions. The second part of the questionnaire included more targeted questions and focused on the specifics of the collaborative research initiative being presented, on ways of assessing the impact of collaborative research and on the main lessons learned throughout the process. This part also included several open-ended questions, in which universities could provide their views in the form of free text and, in addition, some closed-ended questions.

1.2.1 DEFINITIONS AND LEVELS OF ANALYSIS

Definitions for the purposes of the EUIMA case studies included the following:

- Researchers: "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems and also in the management of the projects concerned"[5]

- Collaborative research: "activities where several parties are engaged in research towards shared objectives, collectively building on their individual background and sideground in the creation of new foreground knowledge"[6]

  In the context of this project it refers to research conducted in collaboration with external non-university partners such as industries, Small and Medium Enterprises (SME), Research & Technology Organisations (RTOs), public agencies, Non-Governmental Organisations (NGOs) and charities, civil society and professional bodies.

In the case studies collected through questionnaires, three levels of analysis, characterising the nature and degree of development of the university-business collaborative research initiatives, were developed:

- The project level: a specific short-term collaboration with an external partner with joint objectives limited to the timeframe of the collaboration, where the collaboration has been developed usually through individual initiatives and contacts between academic and business partners;

- The programme level: specific longer-term collaborations inscribed within an agreed common framework of objectives and timeframe and often involving some degree of public funding support through government-led, regional, national or European initiatives. These collaborations can be run by a laboratory, department, innovation hub or other type of university-based organisation;

- The institutional level: programmes, projects and alliances as part of an overall university strategy concerning high-level collaborative research involving long-term jointly-developed partnership agreements (five years and beyond). This level includes initiatives such as research clusters, joint ventures or new postgraduate degree courses at Master's level, and/or collaborative doctoral programmes. As an important distinction from the "programme" level, this level of strategic partnership often involves new forms of joint "governance" in the steering and management of the collaboration.

It is important to note that a case study and its focus may span one or more of these different levels.

[5] Organisation for Economic Co-operation and Development (OECD), 2002, *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development.* (Paris, OECD).
[6] EIRMA, EUA, EARTO & ProTon Europe, 2009, *Responsible Partnering Guidelines.* EIRMA, EUA, EARTO & ProTon Europe.

2. ENGAGING IN COLLABORATIVE RESEARCH PARTNERSHIPS: GOALS AND OUTCOMES

This chapter presents the main outcomes of the EUIMA Collaborative Research project, drawing on the analysis of the in-depth case studies provided by universities and on the contributions of universities, companies and other external partners in the workshops.

This chapter is organised in four main sections. The first section focuses on the motivations driving universities and companies to engage in collaborative research initiatives and on the importance of the regional context in which universities are embedded, as a catalyst of university-business cooperation. The second section presents the main outcomes and benefits of collaborative research initiatives and provides some insights into how universities and companies try to ensure the sustainability of these partnerships over time. The third section describes in more detail the different stages involved in establishing and taking forward collaborative research partnerships. Finally, the fourth section focuses on different types of support institutions provide to university-business research collaborations and on changes undertaken at the institutional level, as a result of long-term collaborative research initiatives.

2.1 CONTEXT AND MOTIVATIONS TO ENGAGE IN COLLABORATIVE RESEARCH PARTNERSHIPS

Overview: The regional context is an important catalyst for university-business partnerships. Universities and their external partners are driven by a variety of reasons to undertake collaborative research projects, such as increasing their competitive advantage, improving or developing innovative products and services and tackling societal challenges.

When universities and companies decide to engage in collaborative research projects, they do not do so in a vacuum. Instead, the regional context[7] in which universities and companies are embedded, the profile of the university and its specific institutional strategy are all factors that play an important role in sparking opportunities for university-business cooperation and in supporting their sustainability over time.

[7] It is important to note that, in the EUIMA project, the concept of region used by universities and companies was varied. Indeed, it could range across a territorial or administrative region or sub-regions within a country, but also to a cross-border region.

In this respect, the regional context in which universities are embedded – including the European, national and regional policies in place, and the geographical proximity to other academic institutions, industries, or innovation hubs – plays an essential role in explaining the emergence and development of university-business partnerships. In addition to the catalyst role of the regional context, universities and companies are driven by a variety of factors or motivations to engage in collaborative research initiatives. These elements are briefly described below.

2.1.1 THE REGIONAL CONTEXT AS A CATALYST FOR UNIVERSITY-BUSINESS PARTNERSHIPS

The input from institutions participating in the EUIMA project showed that universities' regional contexts were characterised by substantial differences in the degree of development and integration of university-business partnerships. However, the common denominator was that all universities were in the process of strengthening their links with the business sector. The main objective sought was furthering regional and local development and establishing university-business partnerships that could contribute to increase competitiveness and innovation and produce added-value products and services.

In some cases, long-term cooperation between universities and external partners was already well established in the region. In others, this collaboration had been accelerated by national or regional-level policies and by the availability of increased funding to foster research, innovation and knowledge transfer. This was the case, for instance, in the examples provided by KU Leuven and Politecnico di Torino, in which there was a high level of integration between the university and companies, as cooperation had been running for many years. In these cases, university-business collaborations had also been catalysed by agreements between public bodies (government, local-level authorities) and academic institutions, with a view to fostering research and furthering the regions' competitiveness.

Another factor that was shown to have a positive impact on the development of university-business cooperation was the existence of industrial and scientific hubs in the region, as well as the emergence of university-business clusters and regional support structures to foster innovation. The availability of public funding programmes aiming directly at the exploitation of research results and at closer linkages between universities and companies was also shown to strengthen the cooperation between the two sectors.

2.1.2 MOTIVATIONS FOR UNIVERSITIES AND COMPANIES TO DEVELOP COLLABORATIVE RESEARCH INITIATIVES

Universities identified several reasons to engage in collaborative research projects. On a more general level, some partnerships, especially research clusters, had been set up with a view to advancing the region's competitiveness, attractiveness and leading role in specific knowledge areas. These collaborations typically involved a number of universities, companies and other non-academic organisations (e.g. government body, regional or local public authority) and ran for several years.

Other collaborative research projects had been initiated with the aim of tackling societal challenges and developing innovative solutions. Many times these projects aimed to tackle societal challenges at the regional or local level, i.e., developing innovative solutions that could be directly applied in the regional context.

Incentives to plan the university-business collaboration also included broadening the university's research funding sources, identifying new research challenges, and the opportunity to translate research results

into specific products or outcomes that could have a direct impact on customers' lives. In the same vein, collaborative research was perceived as a valuable opportunity to maximise the impact of research at the societal level and to further the competitive advantage of the university.

Academic institutions also highlighted the opportunity to develop high-quality research that could lead to an increase in the number of publications and the potential availability of basic research results that could, in turn, be used in future collaborative projects with companies. Collaborative research was also perceived by universities as a chance to enhance the employment prospects of students and early-stage researchers in the non-academic sector and to improve inter-sectoral mobility.

The motivations for companies to engage in collaborative research were, in many respects, similar to those identified by universities.

Strengthening their R&D capacity and increasing their competitive advantage were identified as two key drivers for companies to engage in collaborative research projects with universities. Applying research developed in academia to solve industrial challenges and developing new innovative products or improving existing ones were also motivations identified by companies to take part in university-business collaborations. In addition, some companies mentioned that part of their organisational strategy specifically included developing partnerships with academia and investing in research and development activities. Finally, companies indicated that having access to academic expertise on specific research areas and working with high-profile institutions with strong research capacity in areas relevant for the company were important drivers to engage in collaborative research projects with universities.

Examples from the case studies: Context and motivations for university-business collaboration

KU Leuven: *"The Flemish region has identified three missions for its universities: academic education, research and service to society amongst which the exploitation of research figures highly. To this end, the Flemish Government has provided its universities with the necessary legal framework to engage in effective technology transfer activities (….) This implies that the Flemish Government has given its universities an explicit mission to economically exploit the research they generate. This has led to an extremely dense and intensive involvement of Flemish industry with Flemish universities."*

Politecnico di Torino (Institutional case): *"The Region of Piedmont has assigned research a strategic role in the development of the local economy, considering it an instrument to overcome the current global crisis. For this reason, 'Innovation Hubs (Poli di Innovazione)' have been introduced by EU-law relating to state aids for research, development and innovation, which has been absorbed by the region in its policy."*

TuTech Innovation – Klimzug Nord: *"the objective of KLIMZUG is the development of innovative strategies for adaptation to climate change. The funding activity particularly stresses the regional aspect since global problems such as climate change must be tackled at regional and local level."*

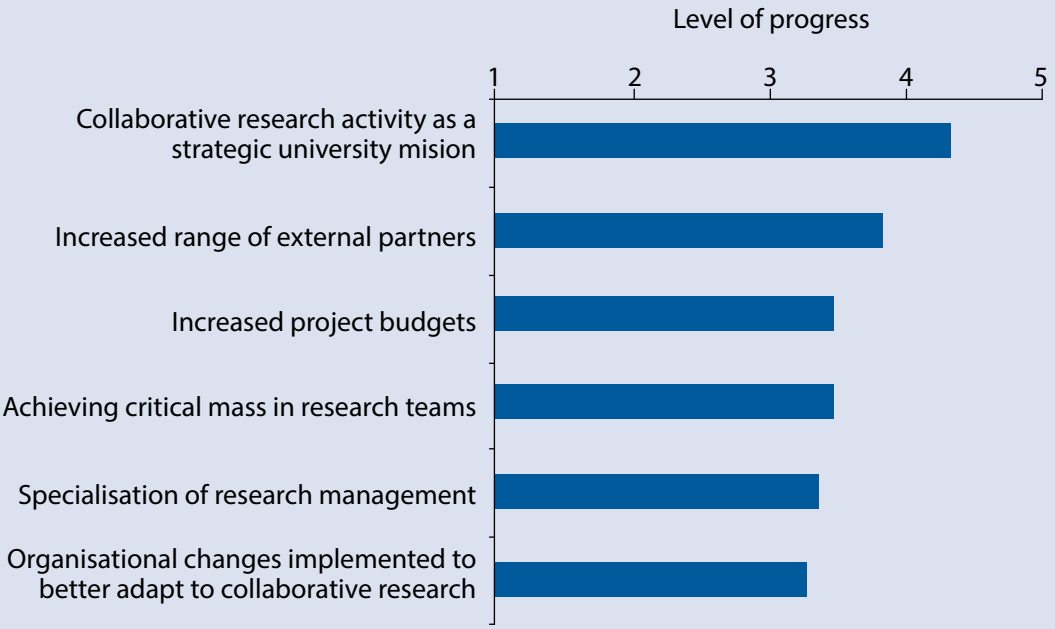
2.2 OUTCOMES, BENEFITS AND SUSTAINABILITY OF COLLABORATIVE RESEARCH PARTNERSHIPS

Overview: Increasing competitiveness and improving the degree of professionalisation of human resources were pinpointed by universities as two major benefits of collaborative research partnerships. Achieving long-term funding availability and identifying and pursuing further opportunities for collaborative research projects were considered the two most important factors in order to promote the sustainability of university-business partnerships over time.

Several benefits of engaging in collaborative research projects identified by universities overlapped with the motivations to take part in these projects.

Overall, universities emphasised two main points: i) collaborative research was an important activity at the institutional level to attract more funding for research and; ii) with long-term university-business partnerships, collaborative research had become a mainstream activity of the university and was increasingly perceived as a natural and integral part of the university's strategy and mission. In fact, the latter outcome was seen by universities participating in the case studies as where they had achieved most progress when considering long-term collaborative research initiatives (see Figure 2).

Figure 2: Consequences of long-term collaborative research



Note: higher values indicate a higher level of progress (1 = low progress; 5 = major progress)

Source: EUIMA Collaborative Research case studies

Universities also indicated other benefits arising from long-term collaborative research partnerships. These referred mainly to two areas: increasing competitiveness and improving the degree of professionalisation of human resources involved in collaborative research activities.

These two areas are described in the next sub-sections. The last sub-section illustrates strategies that universities pursue to ensure the sustainability of their collaborative research partnerships in the long term.

2.2.1 INCREASING COMPETITIVENESS

Universities highlighted that by establishing partnerships with industry, the attractiveness of the region and of the university itself had increased. Indeed, successful collaborative research projects had resulted in enhanced visibility of the university, at both national and international level. In turn, this also attracted new companies, other non-academic organisations and even other universities who wished to explore opportunities for collaboration. The chance to work with other prestigious networks or clusters at national and international level was also mentioned as a benefit of participating in collaborative research projects.

Other positive outcomes of university-business partnerships related to the opportunity to provide solutions for industrial challenges or to provide additional capacity to the industrial partner. Transferring knowledge to society, tackling broad societal challenges and developing research projects addressing "real-life challenges" were also indicated as benefits of undertaking collaborative research projects. A related point made by universities was the opportunity to explore cutting-edge research questions and to identify new research topics arising from the work developed in the collaboration. Enhanced opportunities to use company data and research facilities were also identified as a benefit of university-business partnerships.

Finally, universities also highlighted an increase in the development of interdisciplinary research and in the number of research outputs produced (e.g. publications, patents) as a consequence of collaborative research.

2.2.2 IMPROVING THE DEGREE OF PROFESSIONALISATION OF HUMAN RESOURCES

Collaborative research was perceived as having a positive impact on improving the management structures and the degree of professionalisation of the staff involved in the collaborative project, namely of project management staff. These effects emerged due to discussions among partners and the needed clarification of goals and targets to be achieved in the collaborative research project. Building trust and effective communication, and other requirements of collaborative research (e.g. administrative, financial, legal), propelled university services to re-define their strategy and work to respond more effectively to the characteristics and demands of university-business partnerships. In addition, universities also noted an increase in the provision of training to improve skills needed for collaborative research activities, both for researchers and for research managers (e.g. project management, Intellectual Property Rights, communication, negotiation skills).

A higher number of employment opportunities for early-stage researchers in companies, namely for those who had developed research projects in collaboration with a company, and more opportunities for internships in the firms for undergraduate or Master students were also identified as a positive consequence of university-business partnerships. In addition, more opportunities for students and doctoral candidates to take part in specialised training provided by companies were perceived as a benefit arising from university-business cooperation.

Finally, the intensification of university-business partnerships and the increasing number of university students and doctoral holders from collaborative schemes also contributed to the development of strong alumni networks with other universities and company partners worldwide.

Examples from the case studies: Outcomes and benefits of collaborative research

Chalmers University of Technology: *"The traditionally close cooperation between the university and corporate partners has created a culture where cooperation is seen as a natural and fully integrated activity at Chalmers. The ultimate outcomes are the ability to conduct advanced and relevant research without major limitations to publishing results, contacts for inspiration for new research, enhanced access for PhD students to a labour market outside the university sector, more relevance in higher education, effects of knowledge being used in industrial practise and the additional possibility for the university and its researcher to also benefit from the commercialisation of the results."*

2.2.3 SUSTAINABILITY OF UNIVERSITY-BUSINESS PARTNERSHIPS

Regarding the sustainability of collaborative research activities, the large majority of universities participating in the EUIMA project considered that the continuation of the collaborative research project was highly likely, either because it was part of the overall university's strategy or new projects or even spin-offs were underway. In assessing the sustainability of collaborative research initiatives, most universities highlighted the importance of funding and of developing strategies to identify further opportunities for collaborative research. These two areas were considered essential in promoting the sustainability of university-business partnerships over time and are described below.

2.2.3.1 ENSURING CONTINUOUS FUNDING AVAILABILITY

In some cases, and despite the good prospects for the sustainability of the collaborative research project, continuous funding availability was a concern for institutions. To cope with this challenge, some universities were actively seeking to broaden their research funding sources.

Universities noted the need to recognise that external funders (both public and private) have their own motivations that lead them to foster and support collaborative research. Therefore, universities need to fully understand these reasons, since they affect how institutions engage in collaborative research (e.g. terms and conditions of contractual agreements, expectations on the societal impact of the research project). Furthermore, universities also need to consider and integrate different funding sources for their research activities and, particularly, for collaborative research projects. Therefore, funding sources at the regional, national and European levels should be actively sought.

Universities highlighted, in particular, the importance of public funding in supporting university-business collaboration. They added that given the variety of publicly funded initiatives (e.g. supporting the creation of clusters, framework agreements with universities) it would be useful to assess the efficiency of the various instruments in place in order to identify good practices. This assessment should consider the sustainability of research transfer infrastructure financed through public initiatives, given that financial support is often time-limited and a sustainable model needs to be developed beyond the specific funding period.

2.2.3.2 IDENTIFYING AND PURSUING FURTHER OPPORTUNITIES FOR COLLABORATIVE RESEARCH

In order to ensure the sustainability of collaborative research projects, universities engaged in a variety of strategies. These included maintaining regular communication with existing and prospective industrial partners and also with alumni, monitoring future research and industrial needs which could result in new research projects and establishing framework agreements with non-academic partners for long-term collaborations. Universities also tried to increase the number of Master and doctoral candidates developing their research project with an industrial partner and, in some cases, they promoted high-level meetings between industrial and academic leaders (e.g. industry CEO and university rector). Providing scientific expertise services to the industry partner and integrating non-academic partners in lectures, conferences or other events at the university were also mentioned as strategies to strengthen the ties between the university and the business partner.

Examples from the case studies: Sustainability of university-business partnerships

University of Paderborn – S-Lab: *"While the collaboration appears successful on these partnerships, we are currently pursuing two lines of action to improve sustainability: First, we have fortified the discussion for obtaining basic funding by the university; secondly, we are working on a concept for converging or even merging s-lab and C-LAB in order to build an even more powerful collaborative research institution for computer science at the University of Paderborn. It is especially intended to intensify the presence of industrial partners by adding facets of a collaborative research campus."*

Ruhr University Bochum: *"Sustaining our collaborative partnerships is important for research not only in the case study but on a general level. Therefore, contact to our research partners is constantly held and they are involved in research projects funded by different funding sources (e.g. National funding sources) as often as possible."*

2.3 COLLABORATIVE RESEARCH PARTNERSHIPS IN PRACTICE

Overview: In setting up the university-business partnership, the most important stages are identifying partners for the collaborative research project, negotiating the partnership, involving the research or knowledge transfer office at the university and engaging staff with different professional profiles in collaborative research.

In taking the partnership forward, several challenges may need to be overcome: raising awareness of the added value of university-business partnerships; managing expectations among all stakeholders and finding common ground; dealing with administrative procedures and negotiating agreements; developing comprehensive collaborative research strategies at the institutional level; finding the "right people" and dealing with intellectual property rights.

Overall, trust-building amongst all stakeholders seems to be the "sine qua non" requirement for the success of collaborative research initiatives.

Setting up and taking forward university-business collaborative research projects is a complex process, involving numerous stages and requiring that all stakeholders – universities, companies, other external partners – work together to overcome the constraints that might arise in the development of the partnership.

Naturally, the complexity of collaborative research projects depends on many factors, such as the scientific knowledge areas, the number of partners involved, the goals and expected outcomes of the collaboration. In spite of these differences, some cross-cutting features in establishing and taking forward collaborative research initiatives can be identified.

The main factors that emerged in the EUIMA project to be taken into account when setting up and taking forward university-business partnerships are presented below.

2.3.1 SETTING UP THE PARTNERSHIP

Universities thought that the most relevant areas that needed to be considered when setting up a collaborative research partnership related to:

- Identifying partners for the collaborative research initiative
- Negotiating the partnership
- Involving the knowledge transfer office at the university
- Acknowledging the importance of human resources, in involving different professional profiles in collaborative research

A brief description of each area is provided in the next sub-sections.

2.3.1.1 IDENTIFYING PARTNERS FOR THE COLLABORATIVE RESEARCH PROJECT

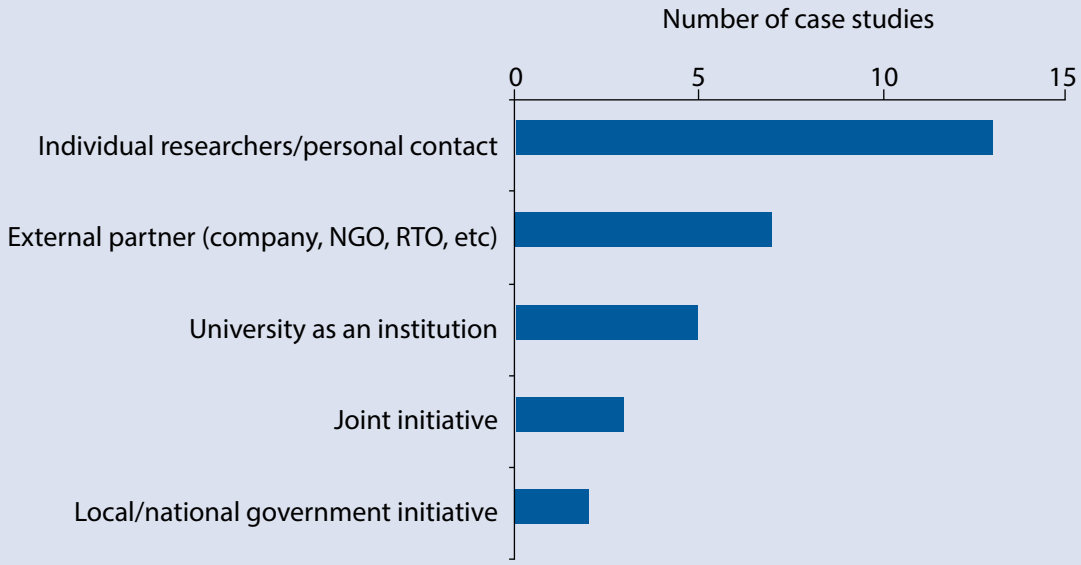
The outcomes of the EUIMA project revealed the importance of finding the right combination of partners and management structures to develop collaborative research projects. While universities reported a variety of strategies to identify potential research partners, one particular strategy was widely used – personal contacts and networks. Indeed, many examples of university-business collaboration seemed to have emerged from the initiative of individual researchers and their professional contact networks. Often, the continued existence of collaborative research activity at the faculty or departmental level emerged and was consolidated in a "bottom-up" way, i.e., from individual researchers and their personal contacts. The informal nature of initial links between the university and external partners, along with the trustful relationships built over time, was considered as one central pillar in collaborative research efforts.

Fairs, congresses, scientific meetings or specialised publications were also indicated as sources for identifying potential research partners. Other strategies relied on universities' structures and/or services, such as the Technology Transfer Office. Some institutions also reported that the university itself was approached by the company who was interested in developing a partnership.

The important role of personal contacts and networks was also apparent in the choice of the leading partner for collaborative research projects. Specifically, the analysis of the case studies showed that, in 13

out of 19 cases, individual researchers or personal contacts were responsible for leading the collaboration (see Figure 3). Some case studies also illustrated examples in which the project was led by one main party, with additional partners providing support, or other cases in which the development of the collaborative project was undertaken by several parties with varying degrees of responsibility in different stages of the process.

Figure 3: Leading partner in the collaborative research project



Note: respondents could give more than one answer

Source: EUIMA Collaborative Research case studies

Examples from the case studies: Identifying partners

TuTech Innovation – Klimzug Nord: *"TuTech as coordinating partner of KLIMZUG-NORD identified the partners through its own existing regional network. Face-to-face contacts and experiences of previous projects were of great relevance."*

Aalborg University: *"For the Case Study: The partners had heard about the technology through the media and business organisations and contacted the inventors/researchers for possible collaboration."*

Münster UAS: *"With respect to the projects acquired by the Science-to-Business Marketing Research Centre, the centre itself takes the lead in developing the project. However, university offices associated with the centre support the developing process with further external partners (such as regional authorities) sometimes completing the project development team."*

Politecnico di Torino: *"Individual researchers or external partners can take the lead in developing a project for example under an FP7 call for proposals, while for more strategic initiatives the leadership of the Institution is necessary (e.g. European Institute of Innovation and Technology)."*

2.3.1.2 NEGOTIATING THE PARTNERSHIP

Negotiating the university-business collaborative research project is a key stage in ensuring the success of the partnership, and it covers a wide range of factors, such as the identification of the research topic to be studied, the specific tasks and milestones each partner is responsible for and administrative and legal agreements.

Universities highlighted that, in defining the research topic and scope of the collaboration, both scientific and management challenges should be taken into account and research topics/activities should reflect the needs and objectives of both academic and non-academic partners. Additionally, universities considered that research topics addressed in collaborative research projects should not be overly determined by the areas covered in the funding calls or by the priorities of the non-academic partner. They also added that, in establishing university-business partnerships and in designing a collaborative research project, careful attention should be paid to defining the expected outcomes of the collaboration.

Regarding the negotiation of collaborative research agreements, universities and companies agreed on the need to allow for flexibility and to tailor the agreement to the specificities of the partners and to the nature of the collaboration. For example, in order to achieve the collaboration's goals, partners may agree on being responsible for different parts of the project or for different tasks (e.g. tasks can be divided into work packages for which specific partners are responsible). Ownership rights of the research results may also be negotiated taking into account the different responsibilities of the partners in the development of each part/task of the project.

With respect to the timeframe from the first initial contacts until the establishment of the collaboration projects, the analysis of the case studies revealed a variety of situations. However, for the large majority of collaborative projects, its development took between six months to over two years. In seven case studies, this stage took from one to two years. Politecnico di Torino, for example, detailed how the timeframe to set up a collaborative project varied as a function of its funding source. For example, projects funded by national, regional or structural funds could typically take two to four months to be established, while European funded projects could take between six and eight months, and research projects funded by private companies typically took from two to twelve months from the first contacts until the establishment of the partnership.

2.3.1.3 INVOLVING THE RESEARCH/KNOWLEDGE TRANSFER OFFICE

In setting up university-business partnerships, institutions highlighted the role of the research transfer office or of other offices at the university, namely in:

- Identifying the needs of the company seeking a partnership with the university
- Matching those needs with the university's know-how
- Bringing together the university and company
- Organising knowledge-transfer events
- Providing broad legal and administrative assistance to the partnerships

In the majority of universities involved in the EUIMA project, the role of the technology or knowledge transfer office consisted primarily of support in contract negotiation, in particular regarding Intellectual Property Rights. In a few cases, the technology transfer office was also responsible for disseminating information on open calls and potential funding sources for projects and in supporting the development or management structure of collaborative research projects. Universities considered that the main strengths of the technology or knowledge transfer office related to the experience acquired over time in negotiating contracts and the high degree of specialisation and expertise of management staff. They also indicated some challenges and aspects that could be improved in the support provided by the technology transfer office. These included the need to ameliorate the negotiation process of interdisciplinary contracts, lack of time and of human resources to adequately support the negotiation stage of the projects, difficulties

in promoting the added value of technological innovations, especially in its early stages, and lack of experience in negotiating with large companies.

Examples from the case studies: Role of the technology transfer office in setting up collaborative research projects

Aalborg University: *"The role of the Grants & Contracts Office and the Technology Transfer Office was to negotiate the agreement between the parties regarding the project. The role of these offices was furthermore to negotiate the agreements regarding the spin-out company, hereunder investment agreements, shareholders' agreement etc., assignment of patents etc."*

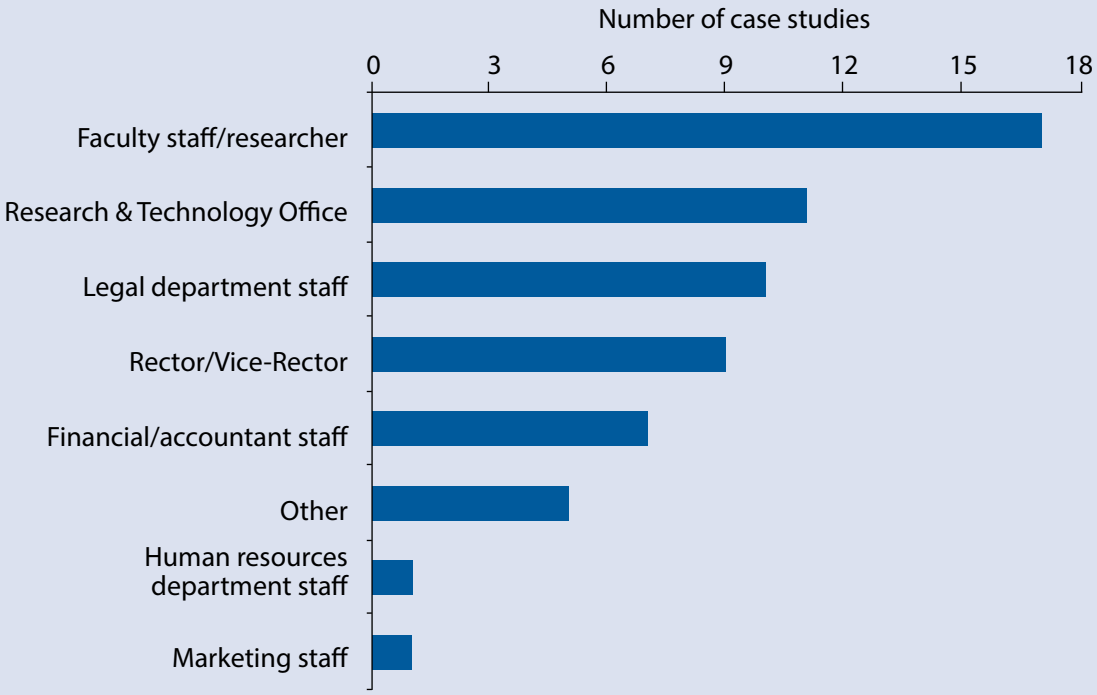
Politecnico di Torino (Institutional and GM cases): *"Improvements could be made in negotiating multidisciplinary contracts, mainly through a better coordination (both scientific and administrative) and sharing of the institutional policy with the involved research teams."*

2.3.1.4 ACKNOWLEDGING THE IMPORTANCE OF HUMAN RESOURCES – INVOLVING DIFFERENT PROFESSIONAL PROFILES IN COLLABORATIVE RESEARCH

When setting up collaborative research projects, different stakeholders within the university are typically involved in the negotiation process.

In almost all case studies, faculty staff or researchers were involved in the negotiation stage of the partnerships (see Figure 4). The research and technology office, the legal department and the rector or vice-rector were also involved in the project negotiation in at least half of the case studies.

Figure 4: Professional profiles of staff involved in negotiating collaborative research projects



Note: respondents could give more than one answer

Source: EUIMA Collaborative Research case studies

Universities emphasised the need for researchers to be involved in the negotiation stage and to learn from this experience in order to improve the process for future collaborative research projects. Other aspects highlighted by universities related to: i) the importance of having a well-developed contact network within the university in order to take the negotiation stage forward and; ii) the need for universities to have sound and reliable support structures for continued human resource capacity building, to ensure that the outcomes of collaboration in specific research domains achieve the desired impact for the university and for all external partners involved in the collaboration (e.g. companies, public authorities, etc.).

A more detailed presentation of the impact of collaborative research on human resources is provided in chapter 2, section 2.5.4.

Examples from the case studies: Identifying partners

Newcastle University: *"We feel that it's good for the researcher who developed the proposal to defend it at the negotiation stage as they then learn useful lessons for subsequent proposals. It is especially important for them to appreciate the difference in level of detail required from proposal to technical annex. If a negotiation is particularly complex, we will request the involvement of our Grants & Contracts department."*

Chalmers University of Technology: *"The most important persons in the internal negotiation are: centre director(s), key professors, department (institution) heads, vice-rector for innovation, chief resource officer. As a result, the head negotiator (often the centre director) must also have a very well developed network inside the university."*

2.3.2 TAKING THE PARTNERSHIP FORWARD

Throughout the EUIMA project, both universities and companies highlighted that in order to successfully take forward university-business research collaboration attention needs to be paid to several factors. Ensuring the smooth development of collaborative research and enhancing and sustaining university-business partnerships over time requires overcoming several challenges and capitalising on facilitating aspects, as described below.

2.3.2.1 FACILITATING ASPECTS AND OVERCOMING CHALLENGES IN COLLABORATIVE RESEARCH

Universities highlighted that long-term experience in establishing collaborative research partnerships and the know-how acquired in this process had helped institutions to streamline their processes and to accelerate the establishment of new collaborative projects. Considerations were made by institutions on the need for a paradigm change in collaborative research. As research collaborations become more widespread, the transition from an era where collaborations are based on personal initiative and individual networks to an era where collaborations are initiated and managed by integrated infrastructure, such as clusters or research transfer support facilities, will tend to become more apparent. Importantly, this infrastructure has the potential to offer a professional range of services to support the work of researchers and to give research more visibility to potential external partners.

Regardless of which paradigm characterises a collaborative research project, both universities and companies agreed they must work together to overcome challenges and bottlenecks that will likely emerge during the collaboration process.

The main challenges to collaborative research and ways forward to overcome them are presented below.

RAISING AWARENESS OF THE ADDED VALUE OF UNIVERSITY-BUSINESS PARTNERSHIPS

Some universities mentioned that companies might not always be willing to work with universities because they may not perceive the added value of such cooperation. This was reported to be much more prevalent with SMEs than with larger companies. In these cases, universities need to persuade companies of the benefits of collaborative research, but many times this task reveals itself to be extremely difficult.

Raising awareness of the value of collaborative research was also deemed to be important in projects involving public authorities and aiming at advancing the region's development. In these situations, it is important to foster dialogue between the university, its external partners and the general public, in order to promote the value of the partnership for all stakeholders.

MANAGING EXPECTATIONS AND FINDING COMMON GROUND

Many universities indicated that one of the most important challenges in collaborative research was ensuring that all partners had a clear common goal and that individual interests did not dominate. A common understanding of the goals, procedures and expected achievements is essential in ensuring a smooth cooperation. This aspect is particularly relevant when the collaboration involves a large number of partners. A related point made is the need to ensure that all partners actively contribute to the project in a continuous fashion and the importance of defining partners' accountability and contributions to the project.

Another cross-cutting challenge in collaborative research related to striking a balance between the different expectations and needs of partners from distinct sectors – academia, industry, public organisations or others. Typically, different partners have different timeframes, expect different results and have varied work cultures. Defining common goals and approaches is an essential step to overcome this challenge. In this respect, balancing researchers' need for publication of scientific outcomes and companies' interest in technology commercialisation and exploitation seemed particularly important for all stakeholders involved in the EUIMA project.

DEALING WITH ADMINISTRATIVE PROCEDURES AND NEGOTIATING AGREEMENTS

Universities also underlined challenges at the administrative level. These included, for example, difficulties with complex application processes, lengthy and complex administrative procedures, bureaucracy and different administrative or accountancy practices across the different partners. The development of consortium agreements, negotiating partnership contracts and striking a balance between requirements for publication and the need to protect Intellectual Property Rights were also identified as challenges by many universities. In addition, it was also highlighted that, when collaborative research projects were funded by several sources, demands in terms of financial reporting or requirements in terms of research outputs (e.g. reports) could be manifold. Tailored outputs for different funding sources had therefore to be produced and managed effectively, but this obviously added to the complexity of administrative procedures that needed to be taken care of.

An important point made by universities and companies was that when negotiating collaborative research agreements, it is important for partners to be flexible and to tailor the agreement to the specific needs and expectations of the partners, as well as to the particular research project being developed. To ensure the success of the partnership, it is important to define the specific responsibilities of each party, tasks and milestones to be achieved and to establish adequate monitoring processes. This should be done with a view to ensuring the active involvement of all partners throughout the collaborative research initiative and aiming at the sustainability of the partnership in the long term.

Framework agreements between the university and its external partners can be a valuable instrument in collaborative research projects, as they avoid the time-consuming task of negotiating every contract

in a "one-off" basis. However, both universities and companies considered that framework agreements should not be too rigid and over-structured. Instead, they should be conceptualised as "open innovation frameworks", which should include student input and doctoral education into the research collaboration, and hence seek to link the external partner to the university's core mission in teaching and skill development.

DEVELOPING COMPREHENSIVE COLLABORATIVE RESEARCH STRATEGIES AT THE INSTITUTIONAL LEVEL AND FINDING THE "RIGHT PEOPLE"

The need to better integrate collaborative research performed in different departments, faculties or laboratories and identifying the right person(s) with an adequate "skill set" at the university and external partner to work on the collaborative projects were aspects highlighted by universities. A related point was that, in addition to better integrating collaborative research across departments or faculties, a new university identity needed to emerge. Collaborative research often has an interdisciplinary character and its activities typically span different departments and faculties in the same institution. In this context, developing a common identity that is salient and relevant for individual researchers in the different departments/faculties is needed to strengthen the success and importance of collaborative research at the institutional level.

OTHER CHALLENGES

Additional challenges in collaborative research may include, for example, the lack of a long-term strategy in companies for sustainable cooperation with universities and the persistence of some stereotypes in university-business collaboration. Language barriers, time zone differences, geographical distance of partners and cultural and sectoral differences were also identified as challenges to university-business collaborations. Finally, some universities indicated the need to overcome the lack of interest and motivation of some researchers in taking part in collaborative research.

BUILDING TRUSTFUL RELATIONSHIPS: A "SINE QUA NON" STRATEGY FOR THE SUCCESS OF COLLABORATIVE RESEARCH INITIATIVES

Many universities also indicated some strategies employed to overcome the above-cited challenges. These included the importance of establishing personal contacts and building trustful relationships among all partners and the need for all parties to communicate frequently in order to improve monitoring and problem-solving strategies. The importance of geographical proximity between universities and their external partners was also noted, as it increases opportunities for informal discussions between researchers and company representatives, which are essential in developing close and trustful relationships.

Examples from the case studies: Overcoming challenges in collaborative research

Vienna University of Technology: *"Determining and negotiating the (technical) content as well as financial and legal aspects of the collaboration while considering the needs of all scientific and industrial partners and of the funding authorities requires extensive discussions between all parties involved."*

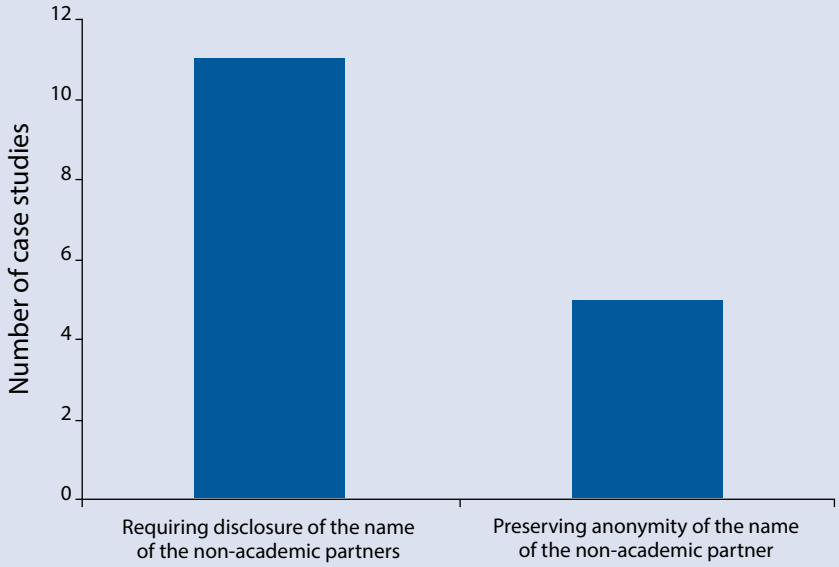
Autonomous University of Madrid: *"The main barrier is probably the cultural differences between university researchers and external partners. Internally one can detect a lack of motivation and interest in professors to engage in collaborative research and innovation on top of the other two classical missions of teaching and research. Often the expectations of university people, particularly in first projects, are unrealistic and their understanding of the perspective and goals of external partners are incorrect. They may lack the managerial skills required to lead a team successfully, project planning may be poor and even attention to technical execution may not be adequate.*
An important skill that university people often lack is adequate risk management during a project. In many collaborative research projects there is a clear risk that they may not be carried through at least as originally planned. It is thus necessary to pay special attention to milestones, evaluate them carefully and frankly and be willing to stop development if this evaluation is negative."

2.3.2.2 DEALING WITH INTELLECTUAL PROPERTY RIGHTS

A particular aspect in the EUIMA project related to Intellectual Property Rights (IPR) in the framework of collaborative research. Universities and companies agreed that negotiations on IPR should be based on the objectives of use and on the fields of application of the collaborative research project and its outcomes. Even though IPR frameworks might exist at the university or company level, specific arrangements should be made on a case-by-case basis to accommodate the needs and interests of all parties involved.

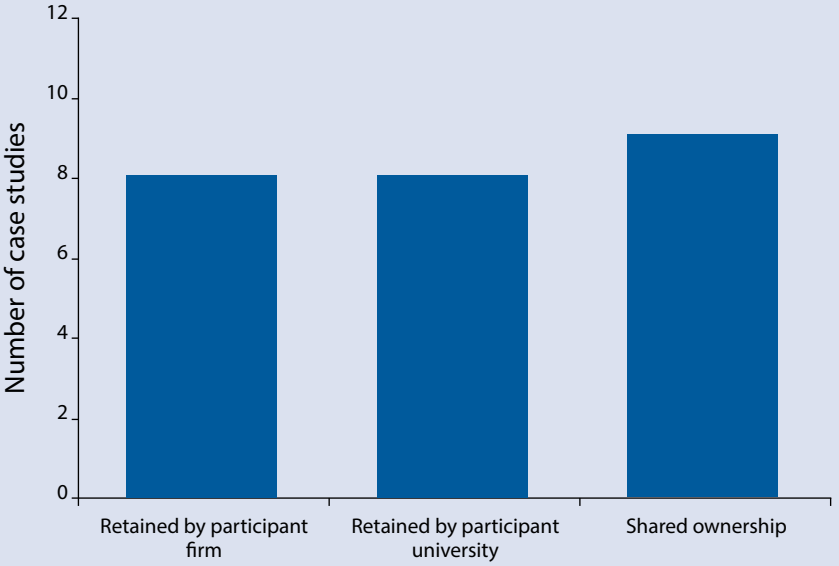
The analysis of case studies revealed that universities and their non-academic partners engaged in different strategies to deal with IPR depending on whether there was potential for commercial application of the research results (see Figure 5 and Figure 6). Regarding the right to publish results with non-commercial application, the most frequent case was disclosing the name of the non-academic partners, an option indicated in 11 out of 19 case studies. When research results had potential commercial application, IP ownership tended to be shared by the firm and the university, although rights retained only by the firm or only by the university were also frequently chosen by respondents in the case studies.

Figure 5: Ensuring right to publication of results with non-commercial application



Source: EUIMA Collaborative Research case studies

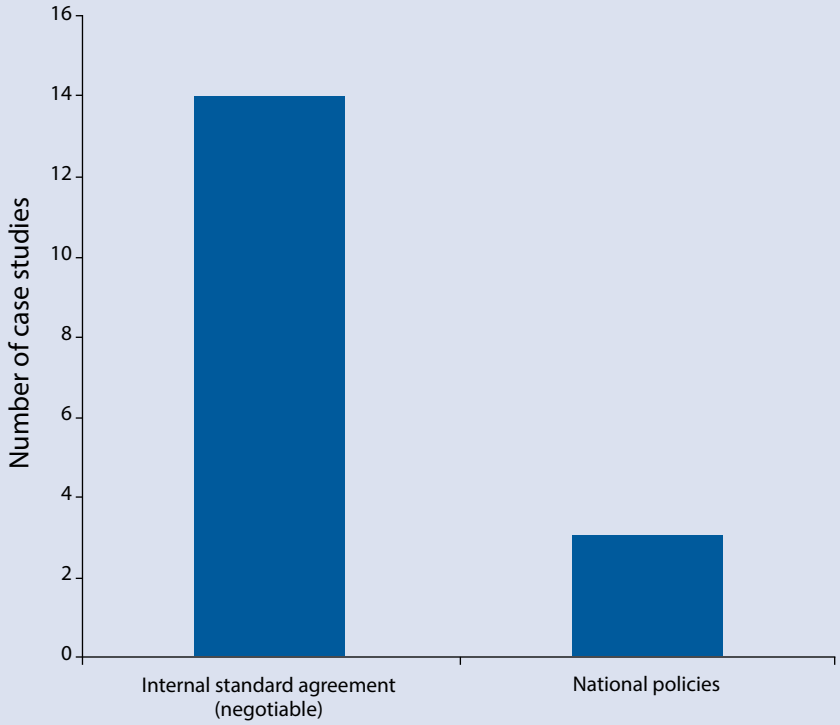
Figure 6: Protecting rights over results with potential commercial application (IP ownership)



Source: EUIMA Collaborative Research case studies

In dealing with IP rights, most universities participating in the case studies indicated that negotiable internal standard agreements were undertaken while only three universities relied on national policies (see Figure 7).

Figure 7: Dealing with IP rights



Source: EUIMA Collaborative Research case studies

Examples from the case studies: Dealing with Intellectual Property Rights (IPR)

Münster University of Applied Sciences: *"With respect to IP ownership, two different IP types have to be differentiated. The firms working with the Science-to-Business Marketing Research Centre retain the rights of the results (as they are most often tailored to the firms' needs), with the centre keeping IPR for the methods developed to generate these results to further use them in the future"*

Chalmers University of Technology: *"The consortium agreement with respect to IP between Chalmers and industrial collaborators is based on a model where Chalmers is the sole owner of the results where Chalmers' researchers have been involved in producing said result. The experience from this contract has not been successful, e.g. no invention has been patented, and we will therefore propose a new model from 2012. The reason for the IP model with Chalmers as a sole owner was to speed up the transfer process of new inventions to a patent through either licensing or transfer of ownership. This proved to be a very long process. In practice, negotiation for every invention is not practical. Therefore, we are in favour of having an IP model where the industry will have an option to go forward and patent, provided Chalmers and its inventors have a fair deal with the partners."*

2.4 SOCIETAL IMPACT OF COLLABORATIVE RESEARCH PARTNERSHIPS

Overview: The regional and the socio-economic impact of collaborative research should be highly valued and tools to assess the societal impact of university-business partnerships should be developed.

The EUIMA project sought to explore whether and how universities and their external partners assessed the societal impact of collaborative research partnerships. The sub-sections below describe briefly the main points that have emerged throughout the project.

2.4.1 VALUING THE REGIONAL AND THE SOCIO-ECONOMIC IMPACT OF COLLABORATIVE RESEARCH

Both universities and companies considered that the concerted actions of institutions within regions and their social and economic impact beyond specific research collaboration projects were of great importance. In this respect, the impact in terms of skill development and enhanced employment opportunities seemed especially relevant. Furthermore, the stakeholders considered that the specific demands and expectations of collaborative research projects needed to be acknowledged by all partners (universities, companies, other external partners) and built into the assessment of collaborative research initiatives from the beginning of the project. Assessing the medium- and long-term regional, social and economic effects of collaborative research activities would inform good practice models and contribute to consolidate knowledge in the area of collaborative research.

2.4.2 ASSESSING THE SOCIETAL IMPACT OF COLLABORATIVE RESEARCH

The results of the case studies revealed that, in the universities surveyed, specific procedures to assess the societal impact of collaborative research partnerships were scarce. However, two universities in the case studies (Politecnico di Torino and Tampere University of Technology) had already conducted research on this topic or, alternatively, had defined a set of indicators to assess the overall impact of the partnership. Some of these indicators included, for example, employment outcomes and market take-up of products emerging from the research project. In contrast to these examples, several universities engaged in informal evaluations of the university-business partnership, i.e., no systematic assessment system was in place, but identification of good practice examples or employment outcomes of the collaboration were considered. In other cases, universities were in the process of discussing internally how to measure the societal impact of collaborative research and how to balance quantitative and qualitative data in this assessment.

Examples from the case studies: Societal impact of collaborative research

Tampere University of Technology: *"In the framework of the TUT RAE following metrics are used – Societal Impact of the Unit's Research: the Unit's interaction with society and industry; societal interaction: most important research projects with non-university partners; commercialisation of research (e.g. spin-offs, patents); expert tasks; placements of the Unit's doctoral graduates from 2005 to 2010 outside the university sector in Finland or abroad."*

Leuphana University of Lüneburg: *"There is an ongoing internal and international discussion on indicators measuring/documenting success of collaborative research projects (…) In particular the UK REF (Research Excellence Framework) approach with a combination of quantitative data with qualitative information (impact statements and case studies based on generic templates) seems extremely interesting."*

2.5 INSTITUTIONAL SUPPORT TO COLLABORATIVE RESEARCH AND ORGANISATIONAL CHANGES AS A RESULT OF UNIVERSITY-BUSINESS PARTNERSHIPS

Overview: The support provided by universities to collaborative research and the organisational changes undertaken by institutions are key aspects in promoting the development of successful long-term collaborative research initiatives. Overall, these aspects relate to different support activities undertaken by institutions, the organisation of knowledge transfer activities at the university level, the impact of long-term collaborative research in the institution's organisational structure and the importance of the quality of human resources involved in the partnerships.

The type of support that universities provide at institutional level to collaborative research encompasses a wide variety of activities and the involvement of several organisational structures. The following sub-sections describe the activities universities undertake to support collaborative research, their impact in the institution's organisational structure and the increasing importance ascribed to human resources involved in collaborative research activities.

2.5.1 GENERAL SUPPORT ACTIVITIES TO COLLABORATIVE RESEARCH

The analysis of the case studies revealed that all universities surveyed had either one or several offices providing support in areas such as:

- Project management
- Grants, contracts and negotiation processes
- Knowledge and technology transfer
- Promotion of linkages between university and non-academic organisations
- Dissemination of funding opportunities

Many of these university offices had also been active in promoting the university and its research results in fora or specialised events with a view to stimulating new university-business partnerships. Universities had also intensified their links with industry by holding joint workshops and inviting an increasing number of external partners to participate in academic activities (e.g. lectures, advisory boards). Disseminating information via the institutional or research unit website, using publications and participating in major conferences were also strategies pursued by universities to both disseminate their research activities and to identify potential research partners (see Figure 8).

Figure 8: Research dissemination strategies used by universities

Note: respondents could give more than one answer

Source: EUIMA Collaborative Research case studies

Some universities that had more long-term relationships with external partners had either founded or were part of excellence centres bringing together scientific and industrial expertise. Others were members of specialised associations aiming at knowledge and technology transfer activities and promotion at the regional level. Several universities had also contributed to the creation of spin-offs, incubators and science parks.

In the case studies illustrating examples of research-industry clusters (e.g. TuTech Innovation), a broader approach to knowledge transfer was apparent. For example, in these clusters support was not only provided with know-how in IPR, financial or managerial issues, but active links with other clusters or industries were actively and continuously sought. The aim was to explore new applications for collaborative research outcomes and to promote the clusters or even the regions at national and international level.

2.5.2 ORGANISATION OF KNOWLEDGE TRANSFER ACTIVITIES AT THE UNIVERSITY

Regarding the organisation of knowledge and technology transfer at the institutional level, universities pursued a variety of strategies and activities. These took place at different levels: project level, programme/departmental level and institutional level.

At the project level, technology and knowledge transfer was driven by the specificities of particular research projects or collaborations. Specific technology and knowledge transfer activities could include the organisation of committees bringing together academic and industrial partners, the existence of advisory groups from industry taking part in academic activities, the recruitment of doctorate holders, particularly those that pursued a collaborative doctoral degree, or researchers working directly in industry

or in spin-off companies. All these activities contributed to transfer knowledge from the university to the business sector. In these cases, the university role consisted primarily in providing administrative and legal support to the technology/knowledge transfer activities.

At the programme level, university departments or institutes were responsible for deciding on and initiating technology and knowledge transfer activities. Similarly to the project level, the university's role was, primarily, of a support and advisory nature. Specifically, universities provided legal and administrative support and advice on funding opportunities and potential for commercialisation.

At the university level, there were also a variety of situations. Many universities had an overarching strategy for knowledge transfer but the degree of involvement with external partners was varied. While some institutions had links with a few external partners, others presented a comprehensive knowledge transfer strategy, which permeated the institution's structure and spanned a variety of partners, including businesses, local, regional or even national-level organisations. For example, in the case of the Norwegian University of Science and Technology (NTNU), a comprehensive technology and knowledge transfer strategy was in place, including close linkages between the university and other research organisations, linkages with business incubators, specific funding strands to accelerate the process from idea generation to product commercialisation, formal networks of academic and industrial leaders.

The example of KU Leuven highlighted the importance of the long-term existence of the university's technology transfer office and the way it had permeated all functional and organisational levels resulting, for example, in more interdisciplinary research. This case also illustrated how researchers could strive for both academic and entrepreneurial excellence. It further described the different roles of its technology transfer office – from the most usual, such as administrative and legal support, IPR management or support in the development of spin-off companies, to the most specialised, such as the creation of open innovation platforms which aimed to transform research results into marketable results more rapidly.

Examples from the case studies: Institutional support to collaborative research

Rovira i Virgili University: *"The University Communication Unit and Fundació Universitat Rovira i Virgili (FURV) centralise the promotion activities towards society and the media. An online newsletter and several activities during the year help to disseminate our R+D activity."*

Istanbul Technical University: *"The partners are identified by the customer, project owner. During the course of the project additional partners may be identified by the project management with the consent of the project management board and related university management."*

Politecnico di Torino (Institutional case): *"The structure of the Politecnico University dedicated to research collaboration with external partners is the Research and Technology Transfer Support Area (SaRTT). Its aim is looking for funding of projects presented in collaboration with enterprises, being in charge of activities on enterprise order, patents and licensing, as well as participating in cooperatives and companies which develop innovation and create high-tech enterprises."*

2.5.3 COLLABORATIVE RESEARCH AND ITS IMPACT ON THE UNIVERSITY'S ORGANISATIONAL STRUCTURE AND WORK PROCEDURES

The long-term engagement of universities in collaborative research activities may be likely to result in organisational changes in the institutions. Universities considered that they needed to identify the value of collaborative research and embed it within the faculty/department structure. This naturally implies a re-

organisation of faculty/department structures, particularly to accommodate interdisciplinary research and new methodological approaches. In addition, universities also noted that the scale of the collaboration was important in determining whether it should be managed through faculty cooperation or through a specific unit (e.g. knowledge transfer office).

Institutional leadership also plays an important role in collaborative research. It should be supported by clear communication channels between the university administration and faculties/departments and the individual researchers and their teams. These were seen as essential components in fostering successful collaborative research within the overall framework of the university's mission.

Several examples of organisational changes at universities as a result of the intensification of collaborative research partnerships were identified in the EUIMA project. These included the creation of specific job posts, in both research and research management areas, with a view to promoting innovation at the university or departmental levels, and the development of institutional or departmental policies for collaborative research. In some cases, universities had also re-structured their services to streamline and improve procedures with the aim of fostering more effective collaborative research.

For some institutions, participation in collaborative research had also resulted in a more articulated research strategy at the institutional level or in the definition of collaborative research as an integral part of the university's mission and strategy. This was also accompanied by changes in the university's organisational structure to foster interdisciplinary research and increase linkages with industry and other non-academic partners.

Examples from the case studies: Collaborative research and its impact in the university's organisational structure and work procedures

Tampere University of Technology: *"In 2007, the university introduced Development Managers for each department. The Development Managers oversee the finances and HR of the department. He/she supports the Head of Department in the overall management of the department. At the project level, the university made it compulsory to nominate a Project Manager for each project, who directly reports to the Responsible Project Leader. The Project Managers are responsible for all administrative tasks within the project whereas the Project Leader concentrates on the scientific content of the project."*

2.5.4 THE IMPORTANCE OF HUMAN RESOURCES IN COLLABORATIVE RESEARCH

Along with changes in the organisational structure and work procedures of universities in order to deal more effectively with the demands of collaborative research, finding the right people to undertake collaborative research projects, both at the university and at the external partner organisations, is crucial to ensuring the success of the partnership. Indeed, universities and companies agreed that a successful collaboration was largely based on the quality of the human resources that were involved. For this reason, universities have been refining their requirements for staff involved in collaborative research and investing in the development of their human resources to deal more effectively with increasingly complex collaborative research partnerships.

In this respect, two specific professional profiles are the cornerstone of collaborative research – researchers and research managers. Both professional profiles should be nurtured by universities and external partners and their skills and training needs should therefore be identified and developed.

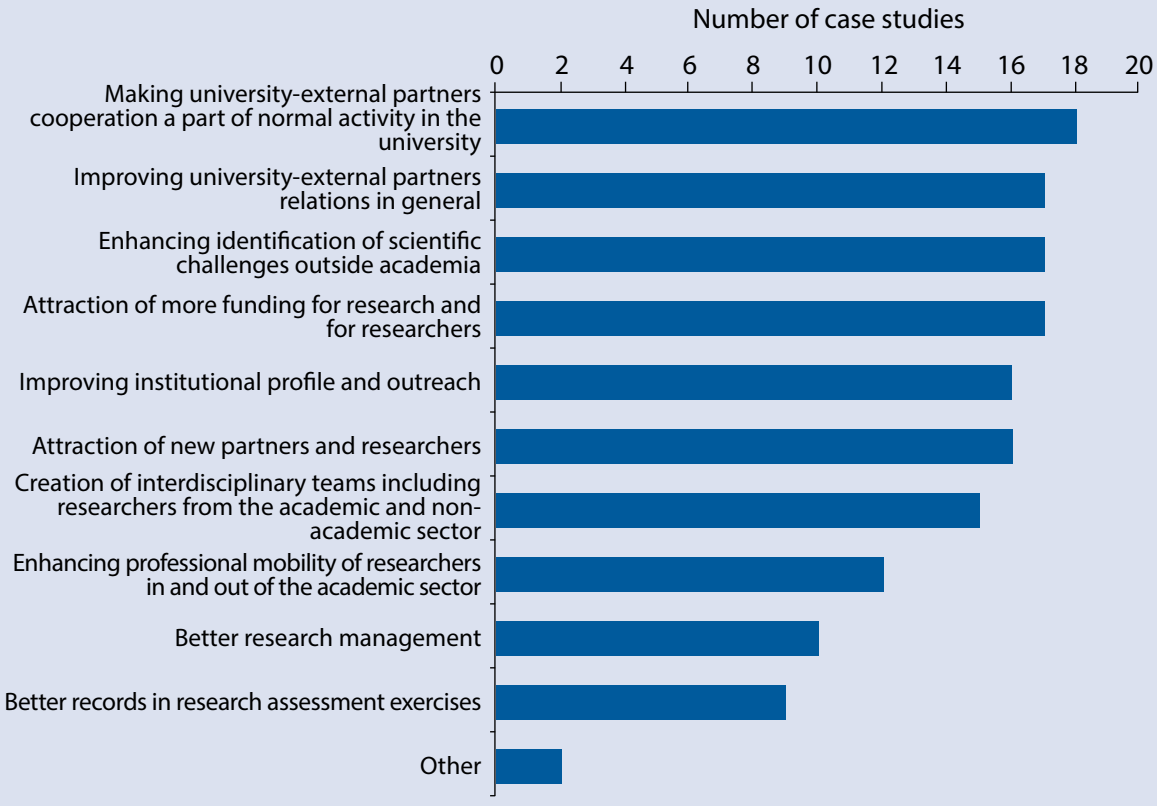
2.5.4.1 THE CASE OF RESEARCHERS

Regarding the skill profile of researchers, when universities decided to recruit research staff, previous experience in collaborative research was a desirable criterion, although not a requirement. This, however, depended on the position for which the recruitment was taking place. In several institutions, previous experience in collaborative research was required for more senior positions, such as professors, but was not mandatory for early-stage researchers, such as post-docs. A few universities indicated, in addition, the fact that considering previous experience in collaborative research as a recruitment criterion also depended on the scientific area of the vacancy, as it was deemed more important in fields such as engineering rather than in humanities. Some difficulty in recruiting researchers that had the right skill profile to work in projects with industry was also mentioned by a few institutions.

In general, most universities indicated that ensuring the continuity of collaborative research projects was very important to securing research positions, as the funding obtained from the collaborative projects was used to finance the research positions created. This was more prevalent for early-stage research positions, such as doctoral candidates and post-docs. For this reason, several universities sought regularly to broaden the scope of their funding sources (public and private sources) and to extend it in time, trying to ensure more long-term funding.

The large majority of universities participating in the case studies identified several benefits that researchers involved in collaborative research bring to the institution, such as turning collaborative research into a normal activity in the university and improving the relationship between the university and its external partners (see Figure 9). Importantly, an increased ability to identify scientific challenges outside academia and attracting more funding for research were also indicated as some of the major benefits researchers involved in collaborative projects brought to the university.

Figure 9: Input from researchers involved in collaborative research and its benefits for the university



Note: respondents could give more than one answer

Source: EUIMA Collaborative Research case studies

All universities involved in the case studies reported an increase in the number of researchers due to university-business collaborative research. In many cases, these new positions were at the doctoral level (doctoral candidates) and to a slightly lesser extent also post-doc level, although this varied by university. Some institutions had even seen the number of researchers increasing twofold or more. However, the impact of collaborative research in promoting the implementation of career development schemes for young researchers had been somewhat limited, but institutions highlighted the added value for early-stage researchers in taking part in collaborative schemes and its benefits for enhanced employment opportunities in the non-academic sector.

Examples from the case studies: Human resources in collaborative research: the case of researchers

NTNU: *"Recruiting Professors, experience in project management and industrial cooperation is one of the important factors evaluated especially at the Engineering Faculty. Recruiting younger Faculty Staff, the importance of these factors is not so much addressed."*

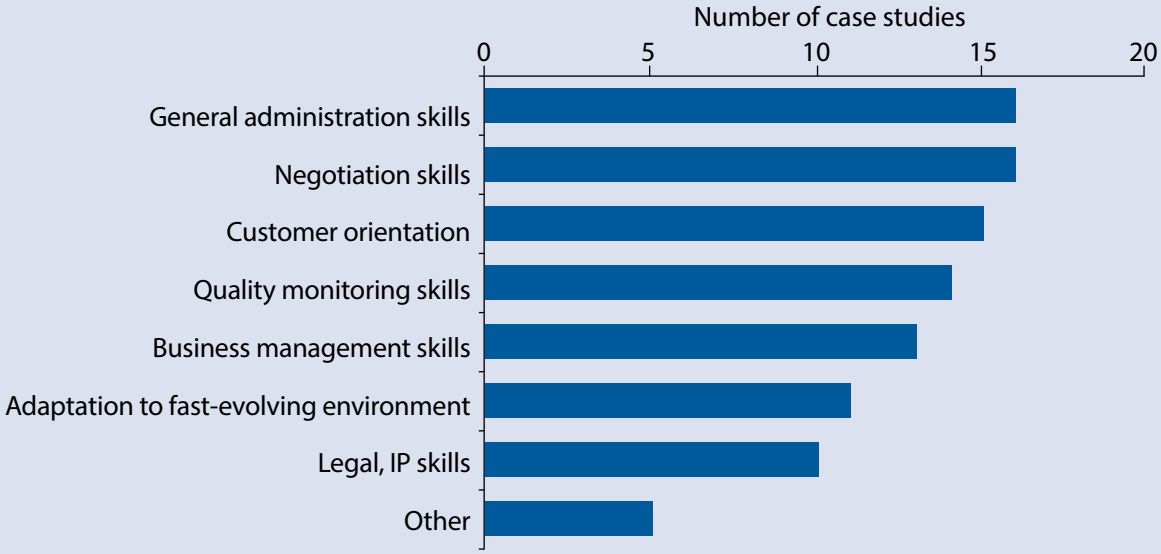
Autonomous University of Madrid: *"It varies in accordance with the scientific areas. For example experience in a collaborative research project is not usually taken into account when recruiting research staff/professors in Humanities, while it is important in Engineering."*

Vienna University of Technology: *"The sustainability of the collaborative research project is generally one of the essential issues in securing the continuity of research positions, as the time limit for externally funded positions correlates with the time limit of the corresponding project."*

2.5.4.2 THE CASE OF RESEARCH MANAGERS

Regarding the professional profile of research managers, the outcomes from the case studies indicated that the skills perceived as the most important for this profile related to general administration, negotiation and customer orientation (see Figure 10). Communication skills, human resources management and relevant specialised knowledge were also pinpointed as important skills for research management staff. Universities also stated the importance of "soft skills" for establishing and taking forward collaborative research projects, disseminating research outcomes and promoting knowledge transfer activities.

Figure 10: Skill profile of research management staff



Note: respondents could give more than one answer

Source: EUIMA Collaborative Research case studies

A mix of external and internal recruitment procedures was used by universities when seeking to employ research management staff. The choice of internal or external recruitment procedures was found to vary across universities, many times due to national-level regulations on recruitment for public sector organisations. Therefore, in some cases, new recruitment procedures needed to be externally advertised, whereas other universities had more autonomy in recruiting and selecting internal staff. Several universities highlighted the need to recruit staff with scientific and technical expertise in the field of the collaborative research project.

The level of institutional autonomy in the recruitment of research managers was also found to vary across different case studies. In nine case studies, complete autonomy in the selection processes was reported, while in eight case studies, universities were only able to make decisions at the skill profile level. Overall, universities had seen an increase in research management staff positions, although the magnitude varied widely across universities. In a few cases, research management was undertaken by research staff; opportunities to change between these two professional profiles were also available in some institutions.

Examples from the case studies: Human resources in collaborative research: the case of research managers

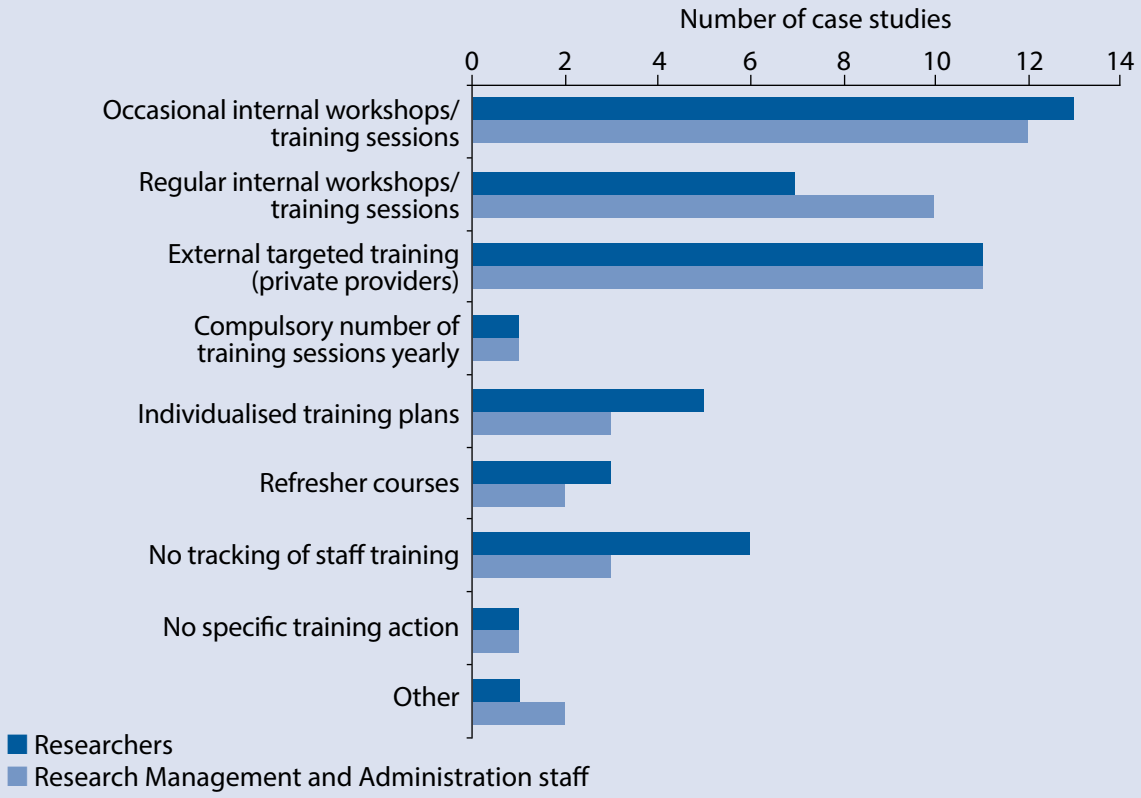
Chalmers University of Technology: *"Internally, we foster young faculty candidates, often successful project leaders, which show leadership skills. It is essential to identify those who have the willingness to act on a broader field than their own area of expertise."*

Ruhr University Bochum: *"[…] at least eight new positions in research management (SET: 5; BML: 2; ESS: 1) have been created at RUB in the last three years in the need to professionalise both the management of interdisciplinary research projects within the university and collaborative research with industry and RTOs."*

2.5.4.3 IMPROVING THE SKILL PROFILE OF RESEARCHERS AND RESEARCH MANAGERS

In order to enhance the skills of staff working in collaborative research, universities participating in the case studies reported using a variety of training activities addressed to researchers and to research management and administrative staff (see Figure 11). The majority of universities provided occasional internal training to researchers and research managers, as well as external training. The major differences between the training provided to researchers and research management/administration staff occurred in the areas of internal workshops/training sessions and individualised training plans. Research management staff was much more frequently involved in regular internal training, whereas individualised training plans were more prevalent for researchers. The absence of tracking systems of staff training was also more frequently associated to researchers than to research management staff.

Figure 11: Training activities for researchers and research managers in the framework of collaborative research



Note: respondents could give more than one answer
Source: EUIMA Collaborative Research case studies

Specific examples of training undertaken by researchers and research management staff covered the areas of leadership, writing of project proposals and research project management. Some universities also indicated that their staff took part in training sessions organised by national-level organisations of knowledge and technology transfer. In contrast, in other institutions the emphasis was on internal training and support.

Importantly, universities pinpointed the main benefits of updating of skills training for research management and administration staff. First, continued training allowed the institution to cope with staff turnover and with leadership changes in order to ensure the continuation of ongoing and future collaborative research projects. Second, continuous training increased the professionalisation degree of research management staff in dealing with collaborative projects. This included the development of a common understanding across staff members of rules and procedures, acquiring skills needed to manage increasingly complex projects and a better adjustment to regular changes occurring both at the university and funding agencies levels (e.g. different rules in different funding programmes, changes in the university's structure or organisation).

Examples from the case studies: Improving the skill profile of researchers and research managers

University of Paderborn – S-Lab: *"Collaborative research requires specific skills that are not generally conveyed in academic education […] project planning, management and administration, but also marketing and communication, legal, financial and tax issues. Researchers need to learn thinking from the perspective of real challenges in practice. Furthermore, intercultural skills are gaining relevance. Training management and research staff in these fields improves the institutions' capability of successfully conducting joint research projects with industrial partners."*

KU Leuven: *"Having a long-standing involvement in technology transfer, our institution has developed a multidimensional approach to training and development. We also co-founded the network & training organisation Leuven.Inc to deal with these issues."*

2.6 LESSONS LEARNED AND RECOMMENDATIONS FROM STAKEHOLDERS

Overall, the outcomes of the EUIMA project showed that universities can make compatible their core missions, such as excellence in academic research, and successful long-term collaborative research activities, provided there is good institutional support. In addition, it was also noted that collaborative research needs to be considered as a "public good", particularly in terms of how it contributes to building sustainable ecosystems of cooperation between the university and its external partners.

Building on their previous experience in university-business partnerships, universities taking part in the EUIMA project proposed several recommendations on how to ensure successful collaborative research projects. These are presented below.

Developing trustful relationships between the partners

Out of all the recommendations provided by institutions, developing and nurturing personal contacts between academia and external partners with a view to building trustful relations was perceived, by and large, as the most important aspect to ensure the success of university-business partnerships.

The role of institutional leadership in promoting and supporting collaborative research

Universities considered that research environments that promote innovation and university-business collaboration should be nurtured. At the university level, leadership competence in promoting collaboration and highlighting its merits and benefits was perceived as crucial. The ability to persuade academic research staff to work across the boundaries of their disciplines in order to harness potential talents for regional innovative activities was seen as a key aspect of such leadership. In addition, collaborative research needs to be linked to teaching at the undergraduate and graduate levels, in order to facilitate the development of professional skills and competences that could then sustain regional development and innovation. In this sense, collaborative research was perceived as instrumental in building critical mass at the regional level.

Identifying relevant research topics for all stakeholders involved in collaborative research projects

Universities drew attention to the importance of basic research. They considered that basic research funding should go hand in hand with national and regional schemes in order to strengthen the knowledge economy and that funding for applied research areas should not dominate and hinder opportunities for developing basic research. Some universities noted that companies generally value excellent basic research conducted in universities and acknowledge the importance of "curiosity-driven" research in spite of its long-term timeframe in the applicability of results. However, it was also recognised that the priority for companies is to allocate funding to research areas in which the company is facing specific challenges. A balance between the research needs of the university and those of the company could be struck in framework agreements.

The importance of public funding

Continued public funding and support was considered essential in all stages of the collaboration, from early stages of idea development or discovery to later stages leading to potentially commercial prototypes and other research outputs.

Defining clear expectations for the collaboration

Outlining clear goals and objectives, defining monitoring and evaluation processes and becoming familiar with IP regulations in the specific research field were aspects considered essential in developing successful

collaborative research partnerships. In addition, actively involving the non-academic partner in all steps of the collaboration since its inception was also perceived as important.

Furthering the institution's role in the knowledge transfer process

Many universities considered that the "technological push model" has been the common paradigm of collaborative research and that university technology offices/structures have been built on this model. For this reason, collaborative research has remained product-based and has not sufficiently addressed important emerging social innovations and services in the economy. The creation of clusters, embedded in their local and regional context, reflects the emergence of a new paradigm in university-business partnerships.

Enhancing the degree of professionalisation of staff involved in the collaborative research projects

Increasingly complex collaborative research projects require a specific skill-set for researchers and research managers; universities and their external partners should seek to identify research staff training needs and provide opportunities for their professional development.

The important role of social sciences and humanities

Universities emphasised the importance of these knowledge fields, namely when key technology fields are increasingly being re-defined in the context of societal grand challenges, such as energy or climate change. In order to address these challenges, cultural and behavioural factors need to be taken into account.

Examples from the case studies: Lessons learned and recommendations from stakeholders

Autonomous University of Madrid: *"'Put the company first'. When collaborating with the university, companies often complain of being treated as the 'flower pot', i.e. a decorative partner with not much involvement. Unfortunately this is often true. For companies and entrepreneurs to be really involved in research activities with the university, it is necessary to give them all the credit they deserve. Academia needs Industry. Academia should not think of 'transferring' its knowledge to Industry, but of co-producing knowledge."*

3. TOWARDS NEW ASSESSMENT TOOLS FOR UNIVERSITIES AND COMPANIES ENGAGED IN COLLABORATIVE RESEARCH

This chapter focuses on the new assessment tool for universities and companies engaged in collaborative research developed in the EUIMA project. This tool has been designed drawing on the contributions of the many universities, companies and other external partners participating in the project, on their experience in collaborative research and on the lessons learned throughout their partnerships.

The new *Assessment Tool for University-Business Collaborative Research Partnerships* (U-B Tool) covers a wide range of factors involved in setting up, taking forward and sustaining successful university-business partnerships. It is addressed to universities and companies/external partners interested in engaging in collaborative research projects or to those already undertaking university-business research partnerships. The distinctive characteristic and added value of this tool, in comparison to existing traditional indicators, is that it focuses on assessing the *quality of the process* of university-business partnerships, as partners – universities and companies – jointly establish, take forward and ensure the sustainability of the research partnerships. The tool, therefore, does not aim at assessing the quality of the research outcomes/outputs produced during the partnership, but rather the *university-business collaboration process*.

The context for the emergence of new assessment tools in university-business collaborative research and the importance of focusing upon the nature and characteristics of the collaboration process are presented in the first section of this chapter. The second section introduces the U-B Tool and its conceptual framework.

3.1 THE EMERGENCE OF NEW INDICATORS TO ASSESS COLLABORATIVE RESEARCH PARTNERSHIPS

As indicated in chapter 1, there is an increasing need in considering a broader range of factors in the assessment of university-based research performance, since it has been particularly dominated by a quantitative and "metric" focus and by the use of indicators designed to assess high performance in fundamental research and in research-intensive universities (e.g. scientific publication citations, Nobel Prizes).

However, as universities evolve in an increasingly complex environment – characterised by new technological, social and economic challenges – so does the need to accommodate this reality in the assessment of university performance. These developments also go hand in hand with the increasing

differentiation of universities' profiles, i.e., the wide variety of university's missions, strategies and "ecosystems". All these factors call for the development of tools to assess the performance of universities in a more comprehensive way, going beyond the traditional quantitative indicators to include more intangible outcomes of university-based research. This applies, in particular, to university-business collaborative research, which was the focus of the EUIMA project.

The project sought to identify indicators used by universities and external partners to assess collaborative research activities. In addition to the traditional indicators already in use, the ones emerging in the EUIMA project have a stronger focus on assessing the quality of the collaborative research process. Universities and companies agreed that collaborative research assessment tools should go beyond the typical "hard" indicators (e.g. number of patents, number of publications) to include more "soft" indicators, reflecting the quality of the research collaboration and the variety of collaborative research outcomes (e.g. increase of research capacity, employability of graduates, Master and doctoral graduates involved in collaborative research, creating and sustaining positions for researchers and research managers). This allows for a more comprehensive image of the manifold effects of collaborative research and illustrates how collaborations are a dynamic process.

The new U-B Tool, developed in the EUIMA project, reflects the variety of outcomes of collaborative research that universities and their external partners can consider when designing and assessing collaborative research projects. The new assessment tool includes more indicators reflecting: i) different forms of collaboration; ii) different qualitative or semi-quantitative outcomes of the partnership; and iii) long-term effects of university-business partnerships in the institutions/organisations themselves and in their environment.

3.2 ASSESSMENT TOOL FOR UNIVERSITY-BUSINESS COLLABORATIVE RESEARCH PARTNERSHIPS

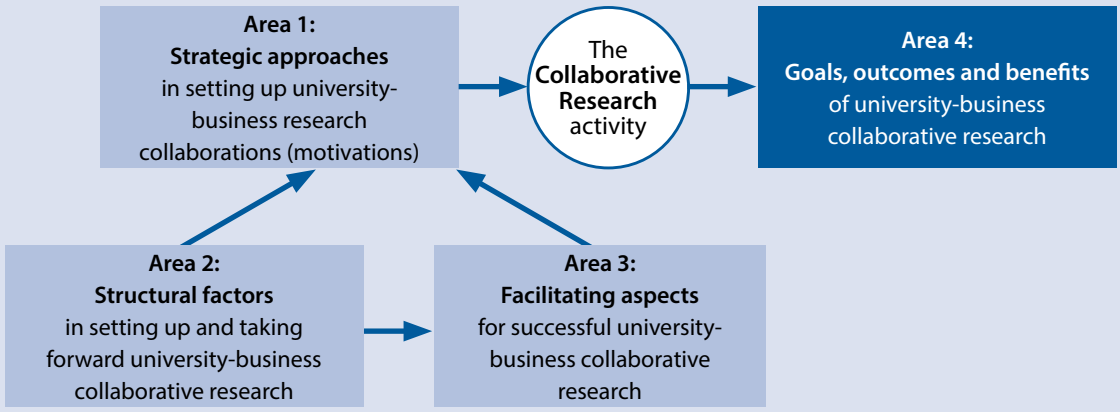
The U-B Tool is a self-assessment tool aimed at universities and companies (or other external partners) interested in undertaking collaborative research projects, as well as those already involved in research partnerships.

This tool constitutes a framework to support universities and companies in reflecting, designing and assessing their collaborative research activities. It focuses primarily on the nature and quality of the collaborative research process, rather than on quantifying measurable outputs of the collaboration. For this reason, most indicators included in the self-assessment tool refer to perceptions about the context, process and outcomes of the collaborative research project. However, some quantifiable/measurable indicators are also included in the tool.

It is important to note that the applicability of the various indicators included in the self-assessment tool to a specific collaborative project depends of course on the characteristics of the collaboration itself (e.g. type of collaborative project, its objectives and developmental stage of the partnership) and on contextual factors, namely the region in which the partnership is embedded, the profile of the university and the profile of the company. Universities and their external partners should come to a clear understanding of the collaboration's objectives and should agree on which indicators are more relevant to assess the outcomes of their particular collaborative research project.

The *Assessment Tool for University-Business Collaborative Research Partnerships* (U-B Tool) is organised in four main areas, encompassing a wide range of factors that come into play at different stages of the collaboration process, as depicted in the figure below (see Figure 12).

Figure 12: Schematic presentation of the Assessment Tool for University-Business Collaborative Research Partnerships (U-B Tool)



Source: EUIMA Collaborative Research project

In the next sub-sections, a complete description of the four areas is presented, along with their constituent indicators. Information is also provided on whether each indicator was identified by universities and/or companies. It is important to note, however, that all indicators may be applicable to universities and companies.

The information provided in the tables below also includes examples from universities and/or companies that explicitly mentioned each indicator. We caution the reader to note that several universities and/or companies may have indicated the use of each particular indicator; hence, the column "Examples" only provides an illustrative case and does not constitute a comprehensive list of the institutions/companies who identified the indicator as relevant.

AREA 1: STRATEGIC APPROACHES IN SETTING UP UNIVERSITY-BUSINESS RESEARCH COLLABORATIONS

This area deals with the strategic approaches and motivations underlying universities' and companies' engagement in research collaborations. It is composed of seven indicators, as presented below.

Indicator and description	Identified by	Examples
Organisational strategy fostering university-business cooperation Existence of an institutional/organisational strategy to develop university-business collaborations. For the university, university-business cooperation may be defined in the institution's mission, strategy and policies. For companies, a corporate strategy may be in place to develop collaborations with one or more universities and/or to invest in R&D activities developed in academic environments.	• Universities • Companies	*"[the university] mission is not any longer alongside education and research, but it is more holistic, active cross-fertilisation amongst the 3 activities is promoted, pursued and sought after"* (KU Leuven) *"Shows the scope of BP's network of collaborating universities which the company sponsors"* (BP)
Increasing R&D capacity The need for universities and companies to strengthen their R&D capacity, in order to increase their competitive advantage in core activity areas. For universities, increasing R&D capacity in core research areas is also related to the aim of pursuing scientific excellence. For companies, R&D development may be linked to efforts to improve global competitiveness by using scientific input (research) into the development of cutting-edge processes, products and/or services.	• Universities • Companies	*"increase capacity to do excellent research"* (Ludwig Maximilian University of Munich) *"technical areas used in STM products which are at the core of POLITO's research activities, which is how the collaboration came about"* (STM)
Applied research to industrial challenges and for the development of innovative products/services Use of the scientific approach and results to solve industrial challenges and to further technological development. This aspect also includes the development of research-based innovative products or services.	• Universities • Companies	*"FTW performs strategic research projects (basic research activities) […] and applies them to obtain results that help to identify, understand, and address expected future real-world challenges"* (Vienna University of Technology) *"application of scientific analysis and design methods to real-world systems"* (FTW COMET)
Access to academic/industrial expertise Opportunity to access specialised scientific or industrial knowledge and benefit from personal and organisational networks available at the university/company. For companies, this aspect may include access to academic research relevant for the company, both in terms of (scientific) methodology and results; working with high-profile institutions with strong research capacity and with academic experts in specific fields relevant for the company.	• Universities • Companies	*"Access to DNV's industrial expertise and network"* (NTNU) *"Building unique knowledge based on academic research in specific areas "* (Omnysis)
Broadening research funding sources Access to diversified funding sources for research in order to reduce dependence on any sole funding source and to ensure proper financial flow for the specific research project/area in the medium and long term.	• Universities	*"diversifying research funding"* (Ludwig Maximilian University of Munich)

Indicator and description	Identified by	Examples
Promoting regional development through university-business cooperation Development of collaborative research projects that aim to have a direct effect at the regional level, by e.g. strengthening specific scientific/technological areas in the region, by capitalising on core research areas of the university that can be easily transferred to the local/regional environment.	• Universities	*"strengthen and exploit Leuphana's RTD capacities in order to increase positive effects on the region in the long term"* (Leuphana University of Lüneburg)
Providing input for policy development Development of collaborative research projects that can have a direct impact on the design or uptake of public policies. This aspect is particularly important when collaborative research projects involve public authorities.	• Universities	*"Proactive institutional engagement in the development of public policy reflecting Government department needs"* (University College London)

AREA 2: STRUCTURAL FACTORS IN SETTING UP AND TAKING FORWARD UNIVERSITY-BUSINESS COLLABORATIVE RESEARCH

This area deals with structural factors in the ecosystem where the university-business collaboration takes place. These factors are of special relevance to reduce structural barriers and to provide adequate support in the establishment and sustainability of university-business partnerships. This area is composed of four indicators, as presented below.

Indicator and description	Identified by	Examples
Organisational and institutional support Support from institutional and company leaders to the collaborative research initiative. This may include the involvement of high-level individuals within the organisation (e.g. rector, CEO) in the establishment and negotiation of strategic university-business partnerships.	• Universities • Companies	*"Commitment from rector and CEO (strategic importance)"* (NTNU) *"Top-level commitment from both parties (CEO and rector)"* (DNV)
Public support to university-business research collaboration Existence of public (regional, national, European) policies supporting university-business collaboration. These policies may also entail the availability of funding or building land provided by public authorities for university-business partnerships.	• Universities • Companies	*"The regional research system of Piedmont has been provided with a single policy framework which defines its objectives and main actions, in order to implement development policies in the knowledge society and to boost system's growth by increasing funds and identifying shared and consistent evaluation criteria"* (Politecnico di Torino, institutional case study) *"Region's thinking behind its support of research collaborations towards sustainable growth"* (Värmland Region)

Indicator and description	Identified by	Examples
Geographical proximity to innovation hubs Existence of regional hubs of innovation, involving universities, knowledge/research transfer offices (KTO/RTO), companies, etc.	• Universities • Companies	*"There are several important company clusters near the UAM Campus, that host many of Spain's leading companies such as Telefónica or Iberdrola"* (Autonomous University of Madrid) *"Shows a network of innovation players in the Piemonte region"* (Torino Wireless)
Key role of the Knowledge Transfer Office (KTO) in the university Importance of the Knowledge Transfer Office at the university as an initiator and facilitator of university-business collaborative research initiatives.	• Universities	*"The structure of the Politecnico University dedicated to research collaboration with external partners is the Research and Technology Transfer Support Area (SaRTT)"* (Politecnico di Torino, institutional case study)

AREA 3: FACILITATING ASPECTS FOR SUCCESSFUL UNIVERSITY-BUSINESS RESEARCH COLLABORATIONS

This area deals with the aspects that facilitate setting up and taking forward successful collaborative research initiatives. These aspects typically unfold over time, as universities and companies define research areas of interest for both parties and as collaborations evolve. This area is composed of eight indicators, as presented below.

Indicator and description	Identified by	Examples
Previous successful experience between the partners Previous relations with the academic/industrial partner, namely when they have been successful, are an important catalyst for further collaborations.	• Universities • Companies	*"Academically and commercially rewarding projects develop from partnerships that are ongoing over many years."* (University of Cambridge) *"Long-term relations"* (Omnysis)
Trustful relationship Building and sustaining trustful relationships among all partners is a key aspect in ensuring the success of university-business collaboration.	• Universities • Companies	*"Building the relationships, building trust"* (Ludwig Maximilian University of Munich) *"Individuals' relationships are key; Allow time for staff to meet"* (Rolls-Royce)
Commitment and interdependence between the partners A high degree of commitment and interdependence among all partners involved in the collaboration. This may include the engagement of partners in overcoming challenges arising during the collaborative research project, sharing responsibilities and tasks and acknowledging partners' valuable contributions throughout the collaboration process.	• Universities • Companies	*"Partners need to […]appreciate the research challenges and research skills of their collaborators"* (University of Cambridge) *"Grow the relationship – interdependency"* (Rolls-Royce)

Indicator and description	Identified by	Examples
Working in a network (open innovation) Development of R&D activities through collaboration with a variety of different partners (e.g., universities, research institutes, companies, SMEs, public authorities). This may also include the involvement of different departments in the same university, particularly in research collaborations tackling interdisciplinary topics.	• Universities • Companies	*"RUB actively fosters close ties with research and technology organisations (RTOs) as well as industry both within the region and beyond"* (Ruhr University Bochum) *"The network FIMECC evolves in comprising research institutes/ universities, industry partners, public funding and shareholders"* (FIMECC)
Interdisciplinary research Interdisciplinary nature of the collaborative research initiative. Involvement of various scientific areas in the development of research.	• Universities • Companies	*"combination of natural and social sciences in an inter- and transdisciplinary approach"* (Leuphana University of Lüneburg) *"multidisciplinary approach made available by the university to the company"* (METALogic)
Efficient contractual negotiation and management processes Streamlining of administrative processes in negotiating and taking forward collaborative research projects. This category also includes the support of specialised staff for legal matters, IPR negotiations and general contractual agreements among the partners.	• Universities • Companies	*"Today, they have grown into highly professional and interwoven support functions that are able to handle the most complex, sophisticated and often international contract and deal structures"* (KU Leuven) *"The company benefited from expertise of KU Leuven in business advice (IP – lawyers, venture capitalists, other entrepreneurs"* (METALogic)
Getting the "right" people profile Recruiting or selecting those individuals with the appropriate skillset to take the partnership forward.	• Companies	*"Choose your partners with care: technical & behavioural"* (Rolls-Royce)
Incentives for researchers to engage in collaborative research Existence of incentives (provided by the university/company) for researchers to engage in university-business collaborative research. These can encompass a wide range of aspects, such as financial compensations, reduction in teaching or administrative duties, etc.	• Universities	*"Rewards for attracting third-party funding, as well as for publications and patents; A special programme for acquisition of additional equipment and modernisation of existing equipment; Reductions in teaching obligations"* (Münster University of Applied Sciences)

AREA 4: GOALS, OUTCOMES AND BENEFITS OF UNIVERSITY-BUSINESS RESEARCH COLLABORATIONS

This area deals with the outcomes and benefits for universities and companies resulting from collaborative research and is divided in five sub-areas, namely:

- Sub-area 4.1: Increasing research capacity, competitive advantage and innovation
- Sub-area 4.2: Institutional/organisational development
- Sub-area 4.3: Strengthening human resources
- Sub-area 4.4: Contribution to regional development
- Sub-area 4.5: Sustainability/planning future university-business collaborations

The sub-areas and their constituent indicators are presented below.

SUB-AREA 4.1: INCREASING RESEARCH CAPACITY, COMPETITIVE ADVANTAGE AND INNOVATION

This sub-area deals with the economic benefits and advancements in the university and company competitive advantage resulting from joint R&D activities. It is composed of seven indicators, which are presented below.

Indicator and description	Identified by	Examples
Cutting-edge R&D activities and value creation for partners For the university, this aspect includes an enhanced institutional focus on cutting-edge research and on scientific excellence, as well as the development of new collaborative research activities (e.g. follow-up research projects, generation of new research ideas). For companies, this aspect is related to performance and competitiveness improvement in the global market. It also reflects the development of applied research tailored to industrial challenges and with direct applicability in the company.	• Universities • Companies	*"the exposure to relevant sectors outside the institution often provides a good platform for new, advanced academic research through the inspiration the cooperation carries"* (Chalmers University of Technology) *"[the] collaboration with Chalmers (and others) [is] essential for Omnisys competitive advantage"* (Omnysis)
Publications Number of publications resulting from collaborative research projects.	• Universities • Companies	*"Numerous journal and conference papers"* (Istanbul Technical University) *"High publication rate"* (Siemens)
Doctoral thesis defended Number of doctoral degrees awarded.	• Universities • Companies	*"higher degrees and PhDs"* (London South Bank University) *"importance of […]PhD thesis publications"* (BP)
Patents/licenses Number of patents and licenses developed in the framework of university-business collaborative research.	• Universities • Companies	*"joint patents"* (Politecnico di Torino, institutional case study) *"Intellectual property management: 61 patents filed (35 licenced)"* (Torino Wireless)
Prototypes Number of prototypes developed in the framework of university-business collaborative research for potential commercial use.	• Companies	*"prototypes"* (Nokia)
Development of new products/services Joint academic and company R&D activities resulting in the creation of new products and/or services. This aspect covers the process from basic research to product commercialisation.	• Companies	*"joint research evolving towards joint products and services"* (Accenture)*
Return on investment (ROI) Gain or loss generated on an investment relative to the amount of money invested.	• Companies	

* *Note:* "development of new products/services" and "return on investment (ROI)" are conceptually distinct indicators of university-business collaborative research, as reflected in their description. However, the examples of companies used to derive these indicators are identical, and therefore, the examples illustrating "development of new products/services" and "return on investment (ROI)" are presented in the same cell.

SUB-AREA 4.2: INSTITUTIONAL/ORGANISATIONAL DEVELOPMENT

This sub-area deals with improvements in the capacity of the institution/organisation to recognise the value and build on collaborative research activities. It is composed of nine indicators, which are presented below.

Indicator and description	Identified by	Examples
Increased awareness of university-business cooperation value Increased institutional/organisational awareness and recognition of the value of university-business collaborative research activities.	• Universities	*"increasing awareness and appreciation of GM/POLITO Institute Initiative"* (Politecnico di Torino, GM case study)
Furthering the university's mission Contribution of university-business collaboration to enable universities to further develop their education, research and innovation missions.	• Universities • Companies	*"via LRD, the third mission of both valorisation and exploitation fully integrates and blends with the educational and research missions of the university"* (KU Leuven) *"Integrate Universities' strategy for Education, Research, Internationalisation, interaction with socio-economic players"* (Torino Wireless)
Visibility/reputation Increased level of public visibility and enhanced reputation of the university/company. This aspect may also include higher media exposure/visibility.	• Universities • Companies	*"This particular business relationship [was] used as a success story in a national campaign to promote technology transfer from university to business"* (Aalborg University) *"Increased awareness (+1 300% in press clippings)"* (The Paper Province)
Attracting students Increasing number of prospective students for the university/company, as a result of common activities between the university and company (e.g. collaborative research job fairs).	• Universities • Companies	*"better position in competition for students"* (Czech Technical University) *"number of students and applications"* (Accenture)
Access to and shared use of infrastructures and human resources among partners Joint use of resources, both material (e.g. facilities) and human (e.g. researchers), by the university and the company. This may include access to and use of research infrastructures available to the partners through the collaborative research activity. This aspect also includes accessing scientific knowledge (basic and applied research) and translating it into the development of new ideas, products and/or services.	• Universities • Companies	*"NTNU and SINTEF share laboratories, professors participate in and supervise SINTEF research project, SINTEF researchers supervise university candidates and give lectures"* (NTNU) *"Access world leading […] facilities"* (Rolls-Royce)
University education or programmes jointly developed and run with companies Joint development of courses or degree programmes (e.g Master, collaborative doctoral degrees) as part of university-business collaboration.	• Universities • Companies	*"[we created the] Master on "Innovative Diesel Engines"* (Politecnico di Torino, GM case study) *"common activities of the partners, including Master and PhDs jointly run and research projects"* (GM PowerTrain Europe)

Indicator and description	Identified by	Examples
Consultancy services Consultancy services provided by researchers to industrial partners or to other external organisations.	• Universities • Companies	*"consultancy activities"* (KU Leuven) *"[Collaborative research] delivers fresh ideas […] consultancy and talent"* (Rolls-Royce)
Appointments to advisory committees Participation of academic and/or industrial representatives in advisory bodies set up by universities, companies or other external partners. These advisory bodies may aim at supporting the development of collaborative research initiatives, evaluating collaborative research projects or transferring knowledge to the university/company. These bodies may include national or international, public or private organisations.	• Universities	*"Advisory groups from industry coupled to large projects transfer the new knowledge from MC2 to their companies."* (Chalmers University of Technology)
Improving the learning experience of students Participation of students in research projects, internships or other activities in companies. This aspect also includes skill development (e.g., entrepreneurship, problem-solving) and pedagogical changes in the teaching approach (e.g. courses and teaching approach focusing on practical issues and on industrial challenges).	• Universities • Companies	*"Student practice and relevance – summer jobs, travelling grants, project work and Master thesis"* (NTNU) *"offer industry-related research and practice for students in their test labs"* (Värmland Region)

SUB-AREA 4.3: STRENGTHENING HUMAN RESOURCES

This sub-area deals with the quantity (number of positions) and quality (professionalisation level) of human resources involved in collaborative research. It also deals with employment prospects of graduates and postgraduates in the non-academic sector.

This sub-area is composed of three indicators, which are presented below.

Indicator and description	Identified by	Examples
Enhanced professionalisation level of human resources Investment to improve the degree of professionalism of the staff involved in collaborative research. This includes providing training for staff on specific areas, improving procedures, etc. This aspect applies to both researchers and research management staff.	• Universities	*"NTNU has come a long way in encouraging and supporting professionalism in relation to external partners"* (NTNU)
Employment of graduates/postgraduates in the non-academic sector Number of employment opportunities in the non-academic sector for graduates and postgraduates, namely for those involved in collaborative research activities.	• Universities • Companies	*"access for PhD students to a labour market outside the university sector"* (Chalmers University of Technology) *"Recruiting of university graduates via attractive tasks and innovative topics"* (Siemens)
Research and research management positions New positions for researchers and research managers, as a result of university-business cooperation.	• Universities • Companies	*"New research management positions at RUB established in 2008-2010"* (Ruhr University Bochum) *"[promoted] career starts of 7 professors"* (FTW COMET)

SUB-AREA 4.4: CONTRIBUTION TO REGIONAL DEVELOPMENT

This sub-area deals with regional growth, development and innovation as a result of university-business cooperation. It is composed of two indicators, which are presented below.

Indicator and description	Identified by	Examples
Regional innovation and economic growth This includes the development and/or creation of new services, companies, clusters, enhanced employment opportunities, attracting funding, etc.	• Universities • Companies	*"help create prosperity for the city and wider region through the creation of new jobs and businesses, and assisting businesses to innovate and grow"* (Newcastle University) *"Consolidation of the District's technological excellences"* (Thales)
Increasing competitiveness of SMEs This includes knowledge transfer processes from universities to SMEs and other similar processes resulting in increased competitiveness and research capacity of SMEs.	• Universities • Companies	*"contribute to the creation of jobs and growth by expanding Leuphana's research activities to SMEs and business partners"* (Leuphana University of Lüneburg) *"Development of a systemic approach for SMEs' acceleration"* (Torino Wireless)

SUB-AREA 4.5: SUSTAINABILITY/PLANNING FUTURE UNIVERSITY-BUSINESS RESEARCH COLLABORATIONS

This sub-area deals with the university/company's engagement in sustaining university-business collaborative research partnerships in the medium and/or long term. It is composed of seven indicators, which are presented below.

Indicator and description	Identified by	Examples
Joint ventures/spinoffs or consortiums Creation of joint ventures, spinoffs or consortiums to take forward collaborative research partnerships.	• Universities • Companies	*"incubator of new knowledge-based companies, including many start-ups by UAM's graduates or PhDs, and about 10 University spin-offs"* (Autonomous University of Madrid) *"From joint research to joint business" introduces the way forward for the collaboration to include joint risks and business benefits towards a public-private "research & innovation" company"* (STM)
Joint applications for further research funding Joint applications of universities and companies for funding to develop new collaborative research projects.	• Universities • Companies	*"joint participation in international, European, national and regional research projects"* (Politecnico di Torino, institutional case study) *"partners jointly apply for funding"* (Accenture)
External funding part of university's budget Financial investment of the company in the university.	• Universities • Companies	*"2/3 of the research activity of the Department of Computer Science is externally funded"* (Karlstad University) *"an investment of $500 million over 10 years"* (BP)

Indicator and description	Identified by	Examples
Development of framework contracts for negotiation and management processes Framework agreements may include aspects such as legal matters and IPR, in order to streamline negotiation and management processes for university-business research collaboration.	• Universities • Companies	*"Template agreement for each collaborative model between companies and MC2"* (Chalmers University of Technology) *"GM and Polito have specific academic partnership research agreements to ease the contractual negotiations processes* (GM PowerTrain Europe)
Long-term commitment in university-business cooperation Universities' and companies' mutual commitment to undertake collaborative research activities in the long term.	• Universities	*"Together they are determined to work out realistic priorities and solutions for the metropolitan area within a framework up to the year 2050"* (TuTech Innovation – Klimzug Nord)
Impact on the organisational structure Changes undertaken at the institutional/ organisational level as a result of continued university-business collaboration, in order to increase the organisation's effectiveness in collaborative research. This may include the creation of new offices, the creation of new staff positions, structural organisational changes, extended responsibilities for the Technology Transfer Office, etc.	• Universities	*"the research division concept introduces a 'de facto' interdisciplinary matrix structure within the university"* (KU Leuven)
Assessment of customer satisfaction Development of a structured assessment of the university/company's satisfaction with the collaborative research initiative. The input of this assessment may then be used to improve specific aspects and to plan future university-business collaborations.	• Universities	*"It provides a critical external view and opinion as well as useful information on quality of research and ground-breaking suggestions especially concerning the planning of strategic research development"* (Vienna University of Technology)

3.3 EXPLORING THE RELATIONSHIP BETWEEN ASSESSMENT INDICATORS AND DIFFERENT FORMS OF COLLABORATIVE RESEARCH PARTNERSHIPS

This section presents an exploratory analysis focusing on the indicators used by universities in the assessment of their collaborative research partnerships and on different forms research collaborations may take – for example those at the project, programme or institutional level (cf. chapter 1, section 1.2.1). These levels of analysis, defined in the first chapter, reflect the differing nature, degree of development and level of engagement of university-business collaborative research initiatives.

Taking into account the information collected in the case studies regarding the nature and level of engagement of the collaborative research initiatives therein presented, as well as the assessment indicators of collaborative research partnerships described above (cf. chapter 3, section 3.2), we have sought to

explore the relationship between these two elements. That is, we have attempted to look into which indicators could be more relevant to characterise different forms of collaborative research taking account of varying levels of complexity.

It is important to note that this analysis constitutes a preliminary attempt at exploring the relationship between the levels of analysis depicting different forms of collaborative research – defined specifically for the purpose of the EUIMA project – and the assessment indicators of university-business collaborative research. Due to the nature of the methodology used in the project, namely in-depth case studies with a strong focus on qualitative information, and the small sample size of the cases collected (19 in-depth case studies collected through questionnaires), the results presented below should be interpreted with caution and the generalisation to other examples of university-business research collaborations is strongly discouraged. The results of this analysis should rather be interpreted as a first attempt to identify the assessment indicators that can be more useful to characterise university-business research collaborations at different levels (project, programme, institutional level). However, further research is needed to evaluate the applicability and relevance of the assessment indicators and the levels of analysis to a broader sample of universities and companies involved in collaborative research.

Given the distribution of the EUIMA case studies (1 at project level, 5 at programme level and 13 at institutional level), the analysis has focused mainly on the programme and institutional levels. It revealed that while some indicators were mentioned in almost all of the case studies, independently of their levels of analysis, others tended to be more associated with a specific level. In addition, the results also suggested that more complex levels of collaborative research encompass the characteristics of less complex levels. That is, the characteristics of the project level are also reflected in collaborative research initiatives at the programme level and, in turn, the institutional level, the most complex, encompasses the characteristics of the programme level.

The key results are presented below and in Figure 13.

- **Assessment indicators shared by collaborative research initiatives across all levels of analysis**

  The presence of three facilitating aspects was widely spread on most case studies: working in a network (open innovation), interdisciplinary research and efficient contractual negotiation and management processes.

- **Programme level**

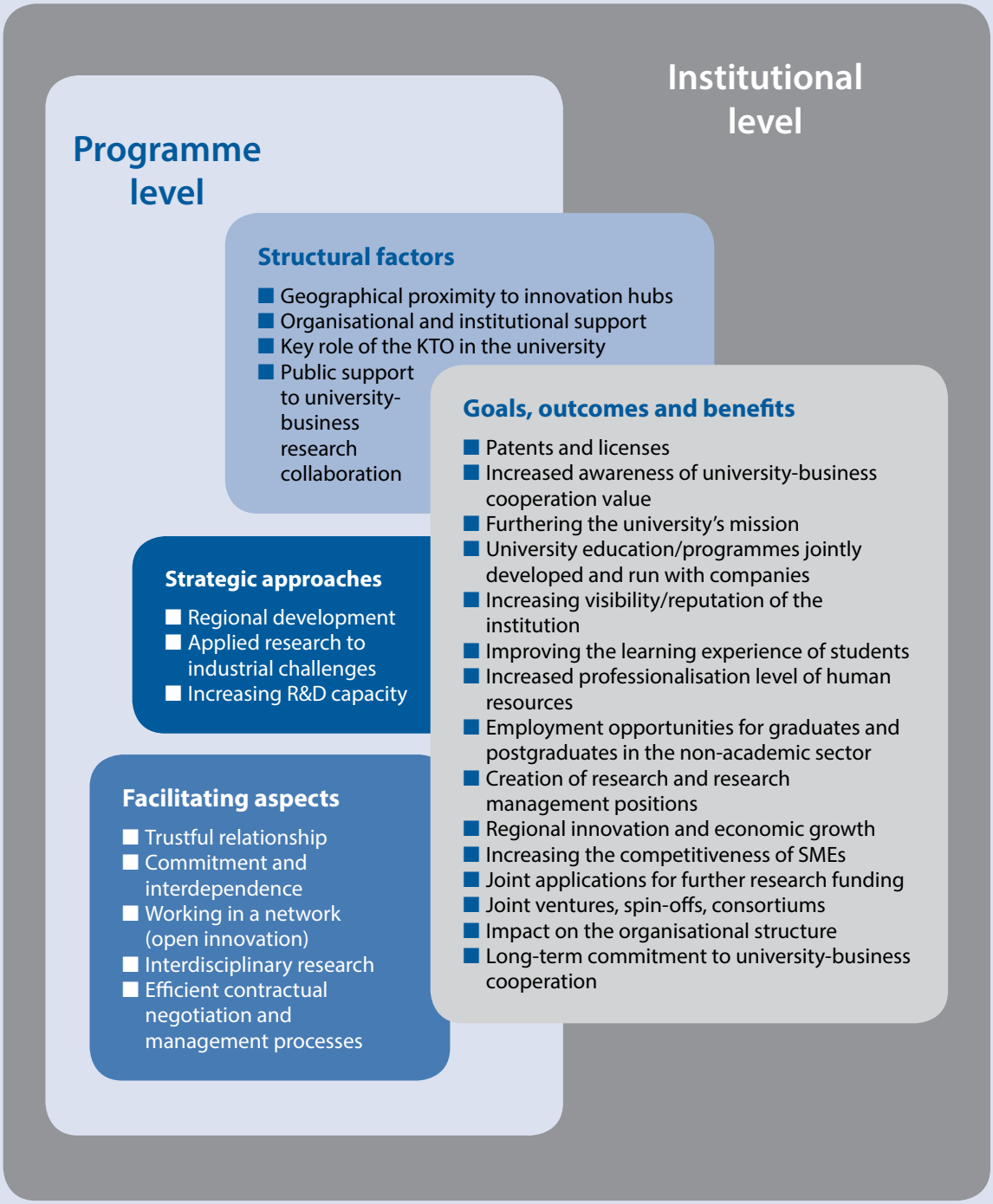
  The case studies illustrating university-business partnerships at the programme level, tended to be characterised by strategic approaches related to regional development, applied research to industrial challenges and increasing R&D capacity. These initiatives were also facilitated by trustful relationships between the partners, as well as commitment and interdependence.

- **Institutional level**

  The case studies illustrating this level tended to be more associated with the presence of structural factors, such as geographical proximity to innovation hubs, organisational and institutional support, the key role of the KTO in the university and public support to university-business research collaboration. In terms of goals, outcomes and benefits of the partnership, these case studies indicated frequently the use of indicators such as: creation of patents and licenses, increased awareness of university-business cooperation value, furthering the university's mission, the development of university education/programmes jointly developed and run with companies (e.g. Master, collaborative doctoral degrees). Related indicators included increasing visibility and reputation of the institution, improving the learning experience of students, increased professionalisation of human resources, employment opportunities for graduates and postgraduates in the non-academic sector and creation of research

and research management positions. Regional innovation, increasing the competitiveness of SMEs, joint applications for further research funding, creation of joint ventures, spin-offs or consortiums, impact on the organisational structure and long-term commitment to university-business cooperation were also indicators that tended to characterise the institutional-level case studies.

Figure 13: Schematic presentation of the relationship between assessment indicators and different forms of collaborative research



Note: Descriptions of all the indicators included in this figure are provided in chapter 3, section 3.2.

This exploratory analysis constitutes only a first step towards better understanding the relationship between the assessment indicators and different forms of collaborative research – reflected in the analytical levels.

While further research is needed to provide a more accurate picture of the different forms of university-business collaborative research and their characteristics, we consider these preliminary results can be a useful contribution towards better understanding the emergence and evolution of different forms of university-business research collaborations.

We hope these results and, particularly, the new *Assessment Tool for University-Business Research Partnerships* (U-B Tool) can be a valuable contribution for universities and companies interested in or already engaged in research partnerships. For its part, EUA will continue to collect further evidence on university-business research partnerships and to explore the characteristics of different forms of collaborative research partnerships. We hope to continue providing solid evidence on the topic of university-business research partnerships and fostering the dialogue among EUA members and other relevant stakeholders.

4. CONCLUSIONS

The EUIMA Collaborative Research project sought to gather a comprehensive view of the process of establishing, taking forward and assessing the quality of university-business research partnerships. To this end, the project involved a wide range of partnerships of universities, companies and other external partners, from different European countries and from varied industrial sectors and knowledge areas (Science, Engineering and Technology – SET; Biotechnology, Medical and Life Sciences – BML; and Economic, Social Sciences and Humanities – ESSH). The project aimed at identifying good practices in university-business research collaborations: from understanding the goals, drivers and challenges faced by universities and companies in setting up and taking forward research collaborations, to exploring how successful partnerships can be consolidated and sustained over time.

The outcomes of the EUIMA Collaborative Research project are put forward as a contribution to the growing body of evidence on the importance of university-business partnerships, which shows that research collaborations are instrumental in developing research and technological advancements, in promoting socio-economic development and, more generally, in stimulating innovation. University-business partnerships also play a pivotal role in tackling societal challenges and in providing innovative solutions that can be applied at the local, regional, national and international levels, and that benefit a wide range of stakeholders (e.g. universities, companies, SMEs, regions).

The main conclusions from the EUIMA project, presented below, highlight some of the most important aspects in developing successful university-business partnerships: fostering the strategic mission of universities; providing a closer connection between education, research and innovation; adapting to the evolving needs of the labour market; improving the quality of human resources and ensuring the existence of support structures to effectively promote the flow of knowledge from the university to companies, regions and society at large. Finally, a key major outcome of the EUIMA project is the new *Assessment Tool for University-Business Collaborative Research Partnerships,* which considers a broader range of indicators to assess collaborative research partnerships, namely those focusing on the quality of the collaboration process. The use of these indicators, together with the more traditional quantitative indicators (e.g. number of publications) allow for a more comprehensive view of the manifold outcomes and factors that come into play in university-business research collaborations.

The main conclusions emerging from the EUIMA project can be summarised as follows:

- **Reconciling universities' mission in academic excellence and in collaborative research**

  The input given by universities involved in collaborative research initiatives showed that making compatible universities' core mission of excellence in academic research and successful long-term collaborative research activities is possible. To achieve a good degree of compatibility between the university and its external partners, focused institutional leadership and the provision of appropriate support structures and services is crucial. These aspects foster a research environment that, on the one hand, encourages researchers to engage in collaborative research and, on the other hand, recognises and rewards its success in their future career development.

- **Support structures enable research outreach support from single companies through to industrial districts in reinforcing their innovation capacities**

The role, structure and organisation of intermediary bodies supporting collaborative research (TTOs, KTOs, KEOs, etc.) evolve alongside the institutional commitment to collaborative research activity. In the case of well-established knowledge transfer strategies, many universities had strong mission statements linking their research objectives to the economic regional development. The most effective regional systems had developed a strong coordination between university, local politicians and industry, but the development of a clear and effective university mission statement was seen as a key catalysing factor. Therefore, the development and efficiency of knowledge and technology transfer activity as a whole was shown to be linked to: i) the internal university "research culture" and its ability to converse with companies; ii) the external technical innovation culture, and its level of confidence in research structures as well as its capacity to invest; and iii) the level of development of the regional knowledge exchange "ecosystem".

- **The importance of public funding to sustain long-term collaborative research**

Universities considered that continued public funding is essential in all stages of the collaboration, from early stages of the development of ideas or discovery to late stages, leading to potentially commercial prototypes and other research outputs. Public funding was also considered essential in order to provide structural elements which are beyond the capacity of the individual partners, such as adequate infrastructure (e.g. equipment), political/policy support and regional strategies.

- **The quality of human resources as a crucial factor in developing and taking forward collaborative research activities**

The outcomes of the EUIMA project showed that collaborative research experience is being progressively taken into account in assessing the achievements for the career development of university research staff, both for researchers and for research managers. Both professional profiles should be nurtured by universities and their external partners; their skills and training needs should therefore be identified and developed. In addition, collaborative research is increasingly instrumental in creating and sustaining academic, technical and support staff positions.

- **The value of collaborative research in informing the development of new syllabuses, courses and postgraduate degrees**

Collaborative research activities were also seen as an asset in reinforcing the interconnection between education, research and innovation. Alongside the traditional mission of universities in the education of graduates and postgraduates, collaborative research has an important role in stimulating universities to adapt their syllabuses, courses and degree programmes to new teaching environments and to innovative research areas. In addition, collaborative research also has a key role in tailoring education to the evolving needs of the job market, maximising the employability of graduates and of postgraduates.

- **The emergence of new tools to assess the quality of collaborative research processes**

In addition to the traditional collaborative research assessment indicators already in use, a new set of assessment indicators is emerging based on the quality of the collaborative processes in partnerships. Assessment criteria in long-term collaborative initiatives evolve throughout the life cycle of the initiative, as the goals or form of cooperation change over time. Hence, assessment tools are dynamic. Their specific targets or degree of achievement may also be different depending on the partners' objectives and degree of maturity of the collaborative research initiative.

This last point, the emergence of new assessment tools, and particularly the *Assessment Tool for University-Business Research Partnerships* presented in this report, constitute one of the major contributions of the EUIMA project to the policy dialogue on university-business cooperation and its assessment. The outcomes of the EUIMA project not only provide a solid empirical contribution to the policy debate, but they also constitute a valuable source of systematised information on university-business research partnerships for universities and companies throughout Europe.

These outcomes aim to stimulate further discussions and bring to the forefront the importance of fostering university-business research partnerships and their beneficial impacts – not only for the university and company directly involved, but also for the broader ecosystem of the collaboration (regional, national and international level).

Finally, we hope that the outcomes of the EUIMA project can serve as a springboard to the development of more and better quality university-business partnerships.

ANNEX 1

FURTHER EXPLANATION ON THE PROJECT METHODOLOGY

EUIMA Collaborative Research: Workshops

In developing the structure for the workshops, special attention was paid to the following aspects:

- **Context:** in the opening session of the workshops, the project's aims and objectives were presented as well as the background work serving as input to the EUIMA project. Host institutions were also invited to present the socio-economic and R&I regional contexts of their collaborations.

- **Thematically focused sessions:** the choice of presentations for each session in the workshop was made in line with the topic being addressed in that particular session (e.g., institutional approaches, project implementation, assessment tools, etc.), which was previously agreed with host institutions and speakers. The programming of workshop sessions sought to offer different perspectives across sessions. Therefore, complementarities were sought throughout the workshop series across the following elements:

  - Level of the collaboration: institutional, programme, project (see chapter 1, section 1.2)

  - Types of external partners: large companies, SMEs, clusters, research institutes, NGOs, public authorities

  - Scale: international, national, regional, local

  - Area of knowledge: SET (Science, Engineering and Technology), BML (Biotechnology, Medical and Life Sciences), ESSH (Economics, Social Sciences and Humanities).

  Over the course of the workshops, the discussions planned at the end of each session facilitated the exchange of views and practice on the following main themes:

  - Collaborative Research from an institutional perspective

  - Collaborative Research oriented towards high-tech products (large companies and SMEs)

  - Collaborative Research within the scope of a "programme"

  - Clusters of academic and non-academic organisations for collaborative research

  - Human resources for collaborative research, both researchers and research managers

  - Organisation of knowledge transfer and the evolving role of knowledge transfer offices

  - Regional contexts and initiatives influencing innovation through university-based collaborative research

- **Presentations in a "double-act" format:** incorporating the views of the two main stakeholders involved in collaborative research activities – the university and the non-academic external partner – in the workshop presentations was a central element of the dialogue. All presentations involved one academic representative and one representative of the non-academic partner. The joint presentations were an essential asset of workshop presentations. They were tested in the first and in the second workshops hosted by Leuphana University of Lüneburg and Tampere University of Technology, and proved to be very successful. This approach was then consolidated as an integral part of the workshops.

- **Time for discussion:** extensive time for discussion was ensured in the planning of the workshop sessions. Discussions were moderated by a member of the Steering Committee or Senior Adviser designated by the project team according to his/her personal expertise in the specific topic of the session. Questions to foster discussion were based on the questionnaire guidelines.

- **Selection of speakers:** these were identified by both the host institution and by the main contact person at the university which had committed to contribute a case study to the project. The project team would have one or several dedicated conversations with identified speakers. These were aimed to: i) achieve a detailed view on the partnership which was to be the subject of a speaker's presentation; ii) identify the aspects of the collaboration which were most relevant to the objectives of the project; iii) provide speakers with the background and methodology of the project as guidance to prepare their contribution; and iv) agree upon the speaker representative for the university and external partner that would represent their respective organisation at a high level and with a deep understanding of the research collaboration projects and initiatives.

- **Practice-sharing and confidentiality:** sustained contact with contributors to the project also allowed creating trust between speakers and the project team. This turned out to be an essential component for the success of workshops. The level of detail of the information sought by the project raised concerns in terms of confidentiality. In this respect, the project team created the trust conditions for participants to share their views and practice on a more informal level. This also meant that participants felt safe to discuss difficulties and concerns in their practice of collaborative research, as this proved to be the situation in which discussions became fully relevant to the project.

- **Perspective of transferability of good practice in collaborative research:** workshop conclusion sessions provided insight from Steering Committee members, project Senior Advisers and participants based on the cases discussed throughout the workshops, reflecting on the potential transferability of good practice examples to other regional contexts.

In the framework of the EUIMA Collaborative Research project, five workshops were organised, as well as a final conference:

- **Workshop 1 – Leuphana University of Lüneburg**, Germany: 5-6 October 2010

- **Workshop 2 – Tampere University of Technology**, Finland: 22-23 February 2011

- **Workshop 3 – Karlstad University**, Sweden: 12-13 May 2011

- **Workshop 4 – Politecnico di Torino**, Italy: 8-9 November 2011

- **Workshop 5 – University of Cambridge**, United Kingdom: 5-6 December 2011

- **EUIMA Project Final Event. Horizon 2020 and the modernisation of European universities – Dialogue with European policy makers**, Belgium: 10 May 2012

An important aspect of all the workshops conducted in the context of the EUIMA Collaborative Research project was the high attendance by company representatives. For each workshop, the industry participation was as follows:

- Workshop 1: Leuphana University of Lüneburg (Germany); 11% company representatives
- Workshop 2: Tampere University of Technology (Finland); 19% company representatives
- Workshop 3: Karlstad University (Sweden); 14% company representatives
- Workshop 4: Politecnico di Torino (Italy); 35% company representatives
- Workshop 5: University of Cambridge (United Kingdom); 33% company representatives

EUIMA Collaborative Research: Case studies questionnaires

The case studies developed in the framework of the EUIMA Collaborative Research project aimed at collecting solid and structured evidence to explore the underlying contexts and motivations leading to the establishment of collaborative research partnerships, their development, sustainability and impact achieved. To this end, the case studies focused on good practice examples in setting up, sustaining and assessing university-based collaborative research initiatives that had been running for a minimum of five years.

An open call for contributions with case studies was posted on EUA's website on 15 January 2010, along with the respective selection criteria. Expressions of interest were welcome until 19 November 2010 but the announcement remained posted on the EUIMA website until the end of the project.

The selection of universities providing case studies to the EUIMA project took into consideration several aspects. First, case studies were selected only if the collaborative research initiative aimed at fostering regional or national development, scientific or technological leadership in a specific field or strengthening the economy. In addition, collaborative research initiatives with more than five years of continued interaction between the university and the company or cluster of companies were sought. Collaborative research initiatives were also selected in cases where the partnerships were seen as a long-term initiative and as a process that built on mutual trust and achievements, with assessment tools that had been evolving along the life-time of the initiative. Finally, a broad range of knowledge fields and representativeness was sought. Therefore, the case studies included examples from different industrial sectors in different fields of knowledge: Science, Engineering and Technology (SET), Biotechnology, Medical and Life Sciences (BML) and Economic, Social Sciences and Humanities (ESSH).

The identification of criteria to select universities providing case studies, the format and questions addressed in the case studies questionnaire and the definition of the three levels of university-business collaboration (see chapter 1, section 1.2) were validated by the EUIMA Steering Committee members of the Collaborative Research strand (Prof. John Goddard, Prof. Paloma Sanchez and Dr Leif Kjaergaard) as well as by the two Senior Advisers (Dr David Livesey and Mr Stephen Trueman).

The questionnaire aimed at providing an in-depth view of the collaborative research project or initiative and it was organised in two broad parts. The first part aimed at gathering key elements of the collaborative research initiative, namely the institutional context and the framework for collaborative research. Universities were invited to provide their views in free form text addressing the following main topics:

- The local socio-economic context of the region (e.g. if there were any strategic plans or initiatives for the revitalisation of the economy in which the university is contributing)
- The environment of the institution in terms of specialised local entities supporting research and innovation (e.g. science parks, innovation hubs, national and regional innovation agencies)
- How the institution supported internally research collaborations with external partners (e.g. through technology transfer office, finance office, legal offices)
- The motivations and incentives of the institution to plan collaborative projects with external partners
- The expected benefits of collaborating with the partner(s)
- The challenges and barriers identified in the relationship with external partners (at both scientific and managerial level)
- Managerial, structural and human resources developments implemented to improve service quality in external collaborations (e.g. communication, negotiation procedures, identification of key contacts and partners, specialised skill developments)
- Recent developments occurring in the last five years in the institution regarding the organisation of research management (e.g. structural aspects, liaison with other internal offices, dedications to specific types of partners)

The second part of the questionnaire presented universities with more targeted questions addressing different areas:

- Collecting core data, where available, on research and collaborative research activity in the institution, faculty or department
- Identifying specific characteristics of the particular collaborative research activity to be presented in the questionnaire
- Identifying the underlying changes brought about by the collaborative research activity in terms of human resources needs
- Gathering information on ways of assessing collaborative research and its impact on the different stakeholders and lessons learned

List of contributing organisations to the EUIMA Collaborative Research project

The following list includes the organisations that were actively involved in the EUIMA Collaborative Research project either in the workshops and/or with structured case studies. These organisations are classified in two broad categories: higher education institutions and external partners. External partners are further classified in the sub-categories: companies, clusters, public authorities, research institutes and research and technology offices. All the organisations listed contributed valuably to the outcomes of the project.

Higher education institutions

The specific role of each higher education institution involved in the EUIMA Collaborative Research strand (workshop organiser, workshop participant, case study provider) is shown in brackets.

1. Vienna University of Technology, Austria (workshop participant, case study)
2. Katholieke Universiteit Leuven (KU Leuven), Belgium (workshop participant, case study)
3. Czech Technical University in Prague, Czech Republic (workshop participant)
4. Aalborg University, Denmark (workshop participant, case study)
5. Tampere University of Technology, Finland (workshop organiser, workshop participant, case study)
6. University of Jyväskylä, Finland (workshop participant)
7. Leuphana University of Lüneburg, Germany (workshop organiser, workshop participant, case study)
8. Ludwig Maximilian University of Munich, Germany (workshop participant)
9. Münster University of Applied Sciences, Germany (workshop participant, case study)
10. Ruhr University Bochum, Germany (workshop participant, case study)
11. University of Paderborn, Germany (workshop participant, 2 case studies)
12. TuTech Innovation, Germany (workshop participant, 2 case studies)
13. Politecnico di Torino, Italy (workshop organiser, workshop participant, 2 case studies)
14. Norwegian University of Science and Technology (NTNU), Norway (workshop participant, case study)
15. Autonomous University of Madrid, Spain (workshop participant, case study)
16. Rovira i Virgili University, Spain (workshop participant, case study)
17. Chalmers University of Technology, Sweden (workshop participant, case study)
18. Karlstad University, Sweden (workshop organiser, workshop participant)
19. Istanbul Technical University, Turkey (workshop participant, case study)
20. London South Bank University, United Kingdom (workshop participant)
21. Newcastle University, United Kingdom (workshop participant, case study)
22. University of Cambridge, United Kingdom (workshop organiser, workshop participant)
23. University College London, United Kingdom (workshop participant)
24. University of London, United Kingdom (workshop participant)

External partners, in partnership with the universities with which they have established research collaborations (all the following participants contributed to the workshops):

Companies

1. METALogic, Belgium
2. ePower Technology ApS, Denmark
3. Nokia, Finland
4. Bernd Münstermann GmbH & Co. KG, Germany
5. HJP Consulting, Germany
6. Siemens AG, Germany
7. GM Powertrain Europe, Italy
8. STMicroelectronics, Italy
9. Telecom Italia, Italy
10. Thales Alenia Space, Italy
11. Det Norske Veritas (DNV), Norway
12. Accenture, Spain
13. REPSOL, Spain
14. Omnisys Instruments, Sweden
15. BP, United Kingdom
16. Rolls-Royce, United Kingdom
17. SHM Productions Ltd., United Kingdom
18. Soil Machine Dynamics Ltd. (SMD), United Kingdom

Clusters

1. Torino Wireless Foundation, Italy
2. Cluster of Steel and Engineering, Sweden
3. COMPARE, Sweden
4. Packaging Arena, Sweden
5. The Paper Province, Sweden

Public authorities

1. City of Tampere, Finland
2. Council of Tampere Region, Finland
3. Tekes, Finland
4. Knowledge Foundation, Sweden
5. Region Värmland, Sweden
6. Swedish Ministry of Enterprise, Sweden

7. VINNOVA, Sweden
8. Higher Education Funding Council for England (HEFCE), United Kingdom

Research institutes

1. Academy of Sciences of the Czech Republic, Czech Republic
2. Institute for Advanced Study Berlin, Germany

Research and technology offices (RTOs) and innovation incubators

1. TuTech Innovation GmbH, Germany
2. Sapienza Innovazione, Italy
3. Service Research Centre, Sweden
4. FIMECC Ltd., Finland
5. ideaSpace, United Kingdom
6. St. John's Innovation Centre, United Kingdom

Country breakdown – the following countries were represented in the Workshops and in the Case Studies of the EUIMA project:

1. Austria
2. Belgium
3. Czech Republic
4. Denmark
5. Finland
6. Germany
7. Italy
8. Norway
9. Spain
10. Sweden
11. Turkey
12. United Kingdom

ANNEX 2

BRIEF PRESENTATION OF EUIMA COLLABORATIVE RESEARCH CASE STUDIES

This annex presents an overview of the EUIMA Collaborative Research case studies. We caution the reader to bear in mind that the EUIMA project ran between 2010 and 2012 and therefore most, if not all, of the collaborations described below have evolved since the project came to its end in 2012.

Case study 1: Vienna University of Technology (TUW, Austria)

The case study presented by Vienna University of Technology addressed mainly the programme level and, to a slightly lesser extent, the institutional level. This case study focused on a centre of excellence initiated by the university, the Forschungszentrum Telekommunikation Wien (FTW). The university's centres of excellence are cross-faculty infrastructure designed to hold critical mass in various fields of expertise. Excellence centres are flexible, with various durations and funding sources. They are meant as a practical organisational response to match partners' needs.

Founded in 1998, the FTW centre saw its partner and governance structure change quickly as the number of projects increased rapidly due to the capacity of the centre to meet the needs of its customers. FTW is a research centre in the area of communication technology and its activities span three types of projects: strategic research, application-oriented projects and product services and development.

> Vienna University of Technology: *"FTW is a nationally leading and internationally renowned Research Centre developing and applying its expertise in communication technology. The industrial and academic members of FTW have the joint goal to drive research and innovation in the fields of communications technologies towards the implementation of Internet Protocol-based technologies used for the development of smartly usable and intelligently manageable distributed infrastructures and environments. The centre's overall strategic research programme concentrates on the advancement of generic technologies that are key enablers for smart infrastructures innovation and value chain creation in telecommunications, transport, and energy."*

Case study 2: Katholieke Universiteit Leuven (KU Leuven, Belgium)

The case study presented by KU Leuven addressed several levels of university-business collaboration, although a stronger focus was put on the institutional and programme levels. This collaborative research case brought together KU Leuven and Samsonite and focused on the development of a new composite material, resulting in the creation of a lightened suitcase.

> KU Leuven: *"The described project is conducted in collaboration with Samsonite and the supplier of the self-reinforcing PP material. In a later stage, a spin-off of the university became subcontractor, delivering other types of honeycomb material, as well as a new technological research institute named SLC, which is a joint initiative of the research institute Sirris and KU Leuven, providing composites-related, application-oriented support to the industry. Furthermore, the described project led to a successful FP7 NMP project in which 8 multinational industrial partners are involved."*

Case study 3: Aalborg University (AAU, Denmark)

Aalborg University's case study addressed a collaboration that emerged from a specific research project. At Aalborg University, a student developed a project in the BML scientific area, more specifically, on cardiology. An invention arising from this project resulted in a patent, for which the university retained the rights. This project resulted in the creation of a doctoral position for the student and several companies approached the university with a view to establishing a consortium and to further developing the product.

> Aalborg University: *"During the course of the student project, the student made an invention in cooperation with his supervisor. The invention was disclosed to the Technology Transfer Office, the rights were assigned to the university and it was patented. Due to the novelty and the highly scientific aspects of the technology, the student was awarded a PhD position financed by the university, to continue his research. The technology was marketed widely in the press and scientific circles and the university followed different strategies for commercialisation. During the course of the PhD study, the university was approached by large companies based in Denmark that had ideas how to commercialise the invention. They suggested that a consortium should be formed and that the parties should apply for funding from the Danish National Advanced Technology Foundation for a project whose aim was to further develop and prove the concept of the technology […] The application was granted and the project was granted approx. €800,000 which was matched by private co-financing of the same amount. During the course of the project funded by the Danish National Advanced Technology Foundation the parties involved decided to establish a separate spin-out company for the purpose of product development and sales. The university assigned the rights to the invention to this company and the other parties contributed with investments. Furthermore, venture capital was attracted successfully. The spin-out company is now working on further development and aims to market the product."*

Case study 4: Tampere University of Technology (TUT, Finland)

The case study presented by Tampere University of Technology addressed mainly the institutional level. It focused on the general approach of the university in collaborative research and not on a specific example of a collaborative research project. The case study described the recent changes in the university that, since 2010, has been operating in the form of a private foundation. Partnerships with the industrial sector are a cornerstone of the university's strategy.

> Tampere University of Technology: *"The Tampere University of Technology (TUT) started on 1st of January 2010 operating in the form of a private foundation (TUT Foundation) […] The Tampere University of Technology is often referred to as 'Finland's industry university' due to its strong collaborative research with non-academic partners. Tampere University of Technology strives to motivate researchers and students to actively exploit research results and inventions. The service is based on cooperation between TUT and regional and nationwide partners."*

Case study 5: Leuphana University of Lüneburg (Germany)

The Leuphana University of Lüneburg case study addressed the institutional level and focused on the example of the Sustainability Sciences Initiative, which is integrated in the Faculty of Sustainability. This initiative combines natural and social sciences in an interdisciplinary approach. At the time this case study was presented, the Leuphana University of Lüneburg was developing a new institutional strategy, based on establishing priorities for its research and teaching strategies in the region with a strong emphasis on collaboration with both public and private partners. The university's strategic approach included the recruitment of new staff with a view to achieving faculty/department integration leading to inter-disciplinary research approaches.

Leuphana University of Lüneburg: *"In the EUIMA project the Leuphana case study will address collaborative research aspects at programme level: the following data is based on the exemplary collaborative efforts of the Sustainability Sciences Initiative which is institutionally integrated in Leuphana's newly formed Faculty Sustainability (since autumn 2010). As part of Leuphana's modernisation process four major science initiatives were built up: Educational Sciences, Management and Entrepreneurship, Cultural Sciences and Sustainability Sciences which is characterised by a combination of natural and social sciences in an inter- and transdisciplinary approach. This is represented both by the new faculty's composition and the curricula of the Bachelor, Master and PhD level."*

Case study 6: Münster University of Applied Sciences (Münster UAS, Germany)

The case study presented by Münster University of Applied Sciences (Münster UAS) addressed the institutional level and, to a lesser extent, the programme level. This case study presented the Science-to-Business Marketing Research Centre (S2BMRC), whose work focuses on a variety of research areas such as entrepreneurship, partnering and knowledge and technology transfer.

Münster UAS: *"Integrated into Münster UAS is the Science-to-Business Marketing Research Centre (S2BMRC) which contributes substantial knowledge about the acquisition of third-party funding by doing extensive research on how to improve university-business cooperation. (…) The research centre puts its research focus on university-business cooperation and examines key factors for the successful commercialisation of research competencies, capacities and results. It develops, validates and provides new models and instruments for research and technology commercialisation and the research-based support on the realisation of market-oriented university-business partnerships. The research areas S2BMRC is focusing on are Partnering, Science-to-Business Marketing, Entrepreneurship, Knowledge and Technology Transfer as well as Commercialisation, Technology Evaluation and Innovation Management/Marketing."*

Case study 7: University of Paderborn (Germany)

The University of Paderborn presented two case studies, C-Lab (case study 7a) and S-Lab (case study 7b).

Case study 7a: C-Lab

The C-Lab case study brought together partners at the University of Paderborn and Atos and addressed primarily the institutional and programme levels. The C-Lab research collaboration has operated successfully for more than 25 years and it focuses on innovations arising through ICT applications based upon a cooperation framework contract rather than on a formal legal entity. In this project, each partner aligns their respective staff and resources to agreed project collaborations for set periods of time in the framework of a long-term relationship. This collaboration has spread to other research disciplines/fields where interdisciplinary perspectives needed to be developed, such as business administration and psychology, in order to take account of market considerations and human behavioural factors.

C-LAB – Paderborn University: *"C-LAB in a certain sense is very special as it is not a 'classical' technology transfer organisation but a real cooperation of two partners for mutual benefit. So R&D is done jointly in mixed teams, consisting of employees of both partners. The results may be used (scientifically and commercially) by each one of the two partners. In case of commercialisation by a single partner the other one has to give its agreement and a compensation to be negotiated case by case has to be provided. It is an essential principle of this concept that no legal entity has been formed. This implies that C-LAB employees are either Atos or university employees. This results in a much closer integration of C-LAB into the two mother organisations compared to a jointly owned legal*

entity. Despite this close integration into only two organisations, C-LAB is closely linked to the local R&D networks. In addition, by being very active in nationally and European-funded collaborative projects, C-LAB is also well interlinked with the relevant national and international academic and industrial institutions."

Case study 7b: S-Lab

The S-Lab case study addressed the programme level. In its foundation, the S-Lab was created based on a strong individual basis, as a collaborative research institute bringing together the faculties of computer science, electrical engineering and mathematics.

S-Lab – Paderborn University: *"s-lab was founded in 2005 as a collaborative research institute of the faculty of computer science, electrical engineering and mathematics by five of its computer science professors. Founding s-lab was inspired by existing individual collaborative research contacts, a culture of transfer and exchange between university and companies through diverse networking activities, and the tradition of joint, interdisciplinary and collaborative research, as manifested by institutions such as the Heinz Nixdorf Institute (interdisciplinary research institute, established 1989) or C-LAB […] S-lab cooperates with the university administration, and the university's legal and transfer offices. However, it has its own research management and administration office and staff for acquiring, managing, and controlling research projects of different kinds and with a diversity of funding schemes."*

Case study 8: Ruhr Universität Bochum (Ruhr University Bochum, RUB, Germany)

The Ruhr University Bochum (RUB) case study had a strong focus on the institutional and programme levels. RUB considered the collaboration with non-university research institutions as an important priority in the framework of a strategy to increase research capacity. The collaborations had the form of joint graduate schools, joint appointments and framework contracts. The case study of RUB depicted the Centre for Electrochemical Sciences (CES), as an illustration of how public and private funding from ThyssenKrupp Steel Europe and SMEs was combined to conduct a range of collaborative projects on an integrated inter-institutional basis in electrochemistry.

Ruhr University Bochum: *"CES is a direct response to the industrial need to address an increasing number of electrochemical issues ranging from materials sciences to biotechnology. In particular, the industrial sectors energy, basic chemicals, polymers, surface refinement, microsystems technologies, diagnostics and environmental monitoring necessitate knowledge and expertise in electrochemistry for product or process development. CES therefore hosts a modern electrochemistry laboratory for solving complex challenges as commissioned by both academic and industrial partners. Moreover, it coordinates collaborative research projects of its members, establishes new collaborations with external partners from industry as well as from other research institutions, promotes early career researchers by funding research activities of several junior research groups, and provides training courses in electrochemistry at different levels and for different audiences within the university and outside the university."*

Case study 9: TuTech Innovation (Germany)

TuTech Innovation presented two case studies, one focusing on industrial biotechnology, Bio Catalysis 2021 (case study 9a), and another focusing on climate change adaptation strategies, Klimzug Nord (case study 9b). Both case studies had their main focus at the programme level.

Case study 9a: TuTech Innovation – Bio Catalysis 2021

The TuTech Innovation – Bio Catalysis 2021 cluster involves TuTech, the Hamburg University of Technology, industrial partners and the Hamburg City Authorities. The main focus of the cluster is the application of biocatalysis for industrial processes. This initiative emerged from the network IBN – Industrial Biotechnology North – which aimed to concentrate existing expertise in industrial biotechnology, exploit synergies and create visibility in the application of biotechnology in northern Germany. The TuTech Innovation – Bio Catalysis 2021 cluster is funded for five years with €20 million and its coordination is the responsibility of TuTech Innovation.

> TuTech Innovation – Bio Catalysis 2021: *"The goal of the cluster BIOKATALYSE2021 is to indicate and to utilise the potentials of the industrial biotechnology for the development of new products and production processes. A particular focus is on the application of biocatalysts for industrial processes […]. The administrative management of the cluster BIOKATALYSE2021 is conducted by TuTech. Due to leadership requirements of a cluster, the multi-dimensional concept integrates multi-projects and programme management. The goal is to optimise the steering of the joint R&D projects of large enterprises, SME, academic institutions and non-university institutions."*

Case study 9b: TuTech Innovation – Klimzug Nord

The TuTech Innovation – Klimzug Nord cluster deals with climate change adaptation strategies in northern Germany. This collaboration brings together public authorities, industry and several academic institutions in the region. The project focuses on the impacts of climate change, particularly in the areas of estuary river management, integrated urban development and sustainable cultivated environment. The project also aims to develop an action plan for the metropolitan area of Hamburg.

> TuTech Innovation – Klimzug Nord: *"Partners of KLIMZUG-NORD are going to research the consequences of climate change to urban areas, agricultural sites and the tidal riverbed of the Elbe within the metropolitan area of Hamburg. Taking into account research data, environmental planning, city law, and economic plans, a range of action plans are going to be recommended. The target entails a coordinated action plan for the city regions, including a master plan up to the year 2050. […] The collaboration is based on a cooperation agreement and on the common target: The aim of the project is to unite the efforts of scientific, economic and technical know-how. Political, administrative, scientific and economical interest groups meet to identify the effects of climate change and shape an action plan. Together they are determined to work out realistic priorities and solutions for the metropolitan area within a framework up to the year 2050. The network aims to establish a master plan (until 2014) for climate change management in the metropolitan area of Hamburg up to the year 2050. [...]The three [main] topics are estuary river management, integrated urban development and sustainable cultivated environment."*

Case study 10: Politecnico di Torino (Turin Polytechnic, Polito, Italy)

Politecnico di Torino submitted two case studies, one addressing collaborative research at the institutional level (Polito institutional; case study 10a) and another addressing the partnership between the university and General Motors PowerTrain Europe (Polito GM; case study 10b).

Case study 10a: Polito institutional

Regarding the case study Polito institutional, the main levels covered were the institutional and programme level. The following quote provides a good overview of the university's strategy in building and sustaining partnerships with the business sector.

> *"Since 2006, the Politecnico di Torino has been adopting a new model in the relations with enterprises, especially medium and big enterprises, which makes use of a new legal and contractual instrument: the partnership agreement. This model, which is the core issue of the best practice that we would like*

to highlight in the relationship between university and enterprise, is based on the assumption that there is a permanent and structured relation whose direct result is an involvement on many integrated fronts, such as placing of orders, financing of industrial doctorates, joint patents, higher education curricula with following professional integration in an enterprise and collaborations in national and international research projects. In some particular and more effective cases, this collaboration is also possible in a shared space, also in a physical space – the Cittadella Politecnica-Politecnico Campus – where academic knowledge is put into practice, like a sort of 'technology transfer laboratory'."

This specific case study focused on the university's organisational model for supporting collaborative research, the Research Support and Technology Transfer Area (SARTT), which deals with EU fund raising, structural and national fund raising and research contracts and technology transfer. In addition, central administrative services on research are also part of SARTT.

Case study 10b: Polito GM

The Polito GM case also addressed the institutional and programme levels. The university and GM have set up a joint centre, the Institute of Automotive Research, which is located in the university campus. The collaboration covers both research and education activities, and it includes internships, master and doctoral programmes, 12 laboratory facilities and more than 600 office spaces. Seven departments at the university have been involved in this partnership and they work on different and specific stages of research, from basic research through to product development. The agreement between the university and GM has a duration of 30 years and it is revised every five years. Partnership agreements have been pre-negotiated – every new contract includes references to pre-agreed principles, thus making the negotiation process of new agreements easier and faster.

Polito GM: *"One of the most successful examples of the new Politecnico-enterprise model is the Partnership with General Motors Powertrain Europe and Politecnico di Torino […] It was the first car manufacturer in Europe to decide to open up a plant not just close to, but inside a university building […] In the framework of the academic partnership research agreement and of the academic partnership agreement on education and training signed in March 2006, GM has established its research centre on diesel engines – in which research activities for the development of all small automotive diesel engines of GM world portfolio are carried out – in the Politecnico di Torino campus, and Politecnico and GM have started a number of joint research projects aimed at the development of innovative, efficient and environmentally friendly powertrain technologies for automotive application, as well as of education activities such as a Master on 'Innovative Diesel Engines'. GM Powertrain together with the Politecnico laid the groundwork for a new way of conceiving the relationship between business and universities, a new model in terms of content but also in the way it was conducted."*

Case study 11: Norwegian University of Science and Technology (NTNU, Norway)

The collaborative research presented by NTNU involved the institution's cooperation with the company DNV (Det Norske Veritas). This case study illustrated an example with a strong focus at the institutional level, since it addressed a long-term collaboration with an external partner and joint strategic objectives. In addition, the university had devised and applied overall policies and processes for collaborative research activities.

DNV, which develops its activity in the shipping, oil and pipeline industries, has several partnerships with universities in Europe, North America and Asia. In terms of its cooperation with NTNU, the main focus areas are in arctic engineering, clean renewable energy and integrated operations. The collaboration between NTNU and DNV involves a five-year framework agreement and covers a wide range of activities related to research, education and training. Regarding the scientific areas of focus in this partnership, although SET is the main component, research activities also extend to ESSH disciplines.

NTNU: *"cooperation between NTNU Norway and DNV involved a framework agreement with a commitment of €1.5 million per year from the company between 2008 and 2013. The agreement covered a full range of research activities from joint research projects, to support for PhD-level research through to professorships. The purpose of the collaboration was focused on scientific and technological development but also to strengthen the education and training of future researchers and prospective new employees. The work was naturally predominant with engineering sciences but it was emphasised that social science research was also supported, e.g. on international legal and regulatory regimes and policy."*

Case study 12: Universidad Autónoma de Madrid (Autonomous University of Madrid, UAM, Spain)

The case study of the Autonomous University of Madrid (UAM) had its main focus at the project level. UAM has established several university-company chairs in different scientific areas. These chairs constitute the first step in a collaboration project and are based on a three-year agreement with the companies. This case study illustrated the collaboration between the UAM and the company Accenture, and it focused on the scientific area of ESSH. Accenture is a consulting and technology outsourcing company who advises its clients in the areas of business management and strategic development. Accenture has supported chairs in the areas of economics and management of innovation. In this specific case study, the collaboration between UAM and Accenture focused on research in the area of innovation policy and innovation policy recommendations.

UAM: *"[…] UAM – Accenture Chairs in the fields of economic and social sciences and the humanities […]chairs were an integral part of an excellent research environment for collaboration that had been built up over many years involving substantial partnerships […] UAM – Company chairs were predominantly with large companies and were usually a first step towards specific project collaboration. 29 chairs had been created so far – 19 in BML fields, 3 in SET fields and 7 in ESSH fields. The chairs were established upon a 3-year agreement on an average funding of €50,000 per year."*

Case study 13: Rovira i Virgili University (URV, Spain)

Rovira i Virgili University presented a case study with a strong emphasis on the institutional level. This case study focused on the university's long-term collaboration with REPSOL. This partnership has brought forward many research contracts since its inception in 1999. It has also extended beyond the research project level with the involvement of the company in teaching and funding.

Rovira i Virgili University: *"In our particular case, REPSOL approached us for the first time in 1999 because, in the data base of the ministries, we had successfully developed Homogeneous Catalysis projects. REPSOL also had information about this expertise, because of our participation in Conferences and Symposiums […]It is important to note that REPSOL and the CTQC [Transfer Technology Office] are partners in projects on sustainable chemistry carried out at the CTQC since 2009. The research contracts, currently developed in the CTQC, have their origin in a previous collaboration between REPSOL and the research group (1999-2009) via the innovation centre TecaT and the FURV […]In this context, an ITN proposal has been submitted in the last FP7 call. This network proposal arises from the expertise and background acquired through this long-term collaboration. The research work developed in collaboration with REPSOL about catalytic systems for industrial applications, as well as the good understanding maintained along the collaboration has prompted us to tackle the training of a new generation of young researchers with skills in the issues of innovative and sustainable processes."*

Case study 14: Chalmers University of Technology (Sweden)

The case presented by Chalmers University of Technology addressed the institutional level and also, to a lesser extent, the programme level. This institution reported on the case of the GigaHertz Centre (GHz Centre). This collaborative research centre specialises on microwave technology and is part of the institution's Department of Microtechnology and Nanoscience (MC2). The GHz Centre has three types of collaboration: advisory consultancy, contract research and joint ventures.

> Chalmers University of Technology: *"The case study in this report, the GigaHertz Centre (GHz Centre), is one of several collaborative projects with industry at MC2. It is by far the largest at MC2 with a turnover of almost €1.6 million per year during ten years […] The GHz Centre has three broad types of collaboration agreements, corresponding to different degrees of collaboration: advisory consultancy, contract research and joint venture […] A general management idea for efficient collaboration is to have a mixture of companies and to avoid bilateral set-ups. The ideal mix is often two large companies with complementary needs (e.g. in our case a company and system enterprise) and also an SME or spin-off which want to highlight their often more innovative ideas for the large companies in the project."*

Case study 15: Istanbul Technical University (ITU, Turkey)

Istanbul Technical University reported on a case study with a strong focus on the institutional level. It addressed the Rotorcraft Centre of Excellence (ROTAM), a research centre that works on the design and development of manned and unmanned helicopters. ROTAM has national and international partners and its organisational structure is composed of academics from different disciplines across the university.

> Istanbul Technical University: *"Rotorcraft Center of Excellence (ROTAM) is a unique National Rotorcraft Centre of Excellence in Turkey, which aims to promote education, academic and industrial collaboration in the field of rotorcraft design and manufacturing. ROTAM has created an academic and research environment to develop rotorcraft design and manufacturing methodologies in collaboration with national and international partners, since 2003 […]Main research activities of ROTAM: Detailed design and development of manned (particularly Light Commercial Helicopter) and unmanned rotorcraft configurations, aerodynamic and structural analysis, control systems development, manufacturing drawings preparation, auxiliary systems and system integration."*

Case study 16: Newcastle University (United Kingdom)

The case study presented by Newcastle University had a strong focus at the institutional level and it also addressed the programme level. This case was based on a research centre, NewRail, which develops its activity in a wide range of areas in the rail industry. The research centre has successfully participated in several EU projects and has strong linkages with international-level companies and other institutions.

> Newcastle University: *"The Newcastle University case study is based around the NewRail research centre and its highly successful participation in the EU's FP6 and FP7 collaborative programmes. NewRail is a dedicated railway research centre with a vast range of expertise in diverse areas of the rail industry. The aim of the research centre is to develop and maintain the highest international standards of excellence in rail-related research. NewRail has a wide experience in applied research for railways focusing on the development and strategic implementation of innovative technologies, with links to the major international players in industry as well as institutions and end users."*

ANNEX 3

EUIMA COLLABORATIVE RESEARCH STEERING COMMITTEE MEMBERS AND SENIOR ADVISERS

The EUIMA Collaborative Research project's Steering Committee members and Senior Advisers provided guidance to the project development and contributed valuably to its success. The complete list of Steering Committee members and Senior Advisers is provided below.

Steering Committee members:

- Prof. John Goddard – Emeritus Professor of Regional Development Studies, Centre for Urban & Regional Development Studies, Newcastle University (United Kingdom)
- Dr Leif Kjaergaard – CEO Leif Food and Science (Denmark); former President of the European Industrial Research Management Association (EIRMA)
- Prof. Paloma Sanchez – Professor of Applied Economics, Autonomous University of Madrid (Spain)

Senior Advisers:

- Dr David Livesey – Life Fellow, Emmanuel College, Cambridge University (United Kingdom)
- Mr Stephen Trueman – Managing Director, La Sapienza Innovazione (Italy)

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