



PROJECT FINAL REPORT

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Executive summary

The project "Promoting Collaborative Doctoral Education for Enhanced Career Opportunities" (DOC-CAREERS II) was a FP7 Support Action that looked at how universities work with businesses and other non-university partners in establishing and taking forward research projects in the framework of doctoral education. It was part of a series of initiatives of the 2008 FP7 PEOPLE Work Programme aiming at responding to the EC objective of reinforcing human resources in research in Europe and of stimulating a culture of mobility and career development. As indicated in that Work Programme, a second phase of the DOC-CAREERS project (FP6) was funded through a FP7 Support Action to "widening the dialogue on good practices initiated towards the broader audience of the European University Association, comprising some 800 higher education institutions, and will result in organising regional workshops discussing how to implement in practise for the local context the recommendations of DOC-CAREERS."¹.

The DOC-CAREERS II project built on the results of the FP6 DOC-CAREERS project (2006-2009), which revealed, among many other conclusions, that i) proximity was considered an essential factor in building the necessary trust between academic and business partners; ii) the organisation of meetings involving high level academic and non-academic experts were seen as a good way to foster mutual understanding of contexts and needs and identify ideas for potential projects of common interest; iii) employability of doctorate holders were linked to mastery of some transferable skills acquired through doctoral research in cooperation with non-academic partners.

The FP7 DOC-CAREERS II project intended to identify good practices in university collaboration with non-academic partners and to test the feasibility of organising regional workshops as one way to foster collaboration between universities and businesses/enterprises or between universities and other external partners. Five regional workshops were held during the project in selected locations in Europe (Ireland, Switzerland, Lithuania, Norway and Italy), bringing together interested partners in cooperation through doctoral education to share and discuss specific tools and incentives that could have wider application across Europe. In addition, case studies of collaborative doctoral programmes were conducted by targeting the university sector and asking institutions to liaise with their doctoral candidates and external partners who were involved in specific collaborative doctoral projects or programmes. The aim was to collect "full stories" from the doctoral thesis conception to employability of the doctoral holder. The workshops also reflected this "full story" approach, as the presentations had the format of a "double act" (university-doctoral candidate or university-business/external partner) or "triple acts" (university-doctoral candidate-business/external partner). The case studies involved a total of 13 universities, covering 18 doctoral programmes and 21 doctoral candidates with experience in collaborative doctorates, as well as 14 companies.

The main results support and extend those found on the previous DOC-CAREERS project. The following messages can be highlighted:

- The existence of a variety of forms of university-industry collaboration, shaped by the characteristics of the research project, the type of university and the type of

¹FP7 PEOPLE WORK PROGRAMME 2008, p. 27

business/company. In addition, ensuring the success of the collaborative programme requires partners who have the right profile and skill set to work in a collaborative scheme. This entails not only being committed to research, but also the ability to develop the doctoral project in an industrial environment, bridging two worlds – academia and industry. An active involvement of stakeholders in all stages of the collaboration, from inception to completion, is also essential to ensure a successful university-business partnership.

- The importance of thoroughly planning the collaborative doctoral scheme, namely with the establishment of contracts/agreements defining the rights and obligations of all the parties involved, including Intellectual Property rights. These agreements are an important instrument to ensure the smooth development of the collaborative doctoral programme.
- Building trustful relationships between the partners is essential. This requires regular contact between the different parties involved, commitment to take the partnership forward and flexibility to understand each other's needs and to find common solutions.
- Collaborative doctoral degrees result in enhanced employability perspectives for doctoral holders in non-academic contexts. This is mainly due to the development of transferable skills and the ability to be "bilingual" in both sectors – academia and industry.
- Regional workshops, bringing together academic and non-academic leaders are an efficient tool for fostering university-business collaboration in the framework of doctoral education.

Overall, this project has contributed to the development and improvement of institutional, regional, national and European codes of practice in collaborative doctoral education, highlighting good practice examples and providing a support network to facilitate university-industry collaboration. It has promoted long-term university-business collaboration and has proven its value in terms of use of outcomes by all stakeholders involved: university, businesses and doctoral candidates. It has highlighted the value of the exposure of the doctoral candidate to the two environments, academic and non-academic, and the consequent benefits for those individuals pursuing an intersectorial career. The project has also shown the benefits of doctorate holders for organisations which, in their development strategy, are interested in long-term R&D investments.

Summary description of project context and objectives

The DOC-CAREERS II project was particularly relevant to the Specific Actions of the European Commission DG Research "2008 PEOPLE Work Programme" (Activity 5.2), in which the general objective was "reinforcing human resources in research in Europe and of stimulating a culture of mobility and career development".

The project "Promoting Collaborative Doctoral Education for Enhanced Career Opportunities" (DOC-CAREERS II) was a FP7 Support Action that looked at how universities work with businesses and other non-university partners in establishing and taking forward research projects in the framework of doctoral education. It intended to identify good practices and to test the feasibility of organising regional workshops as one way to foster collaboration between universities and businesses/enterprises or between universities and other external partners.

The previous FP6 DOC-CAREERS project (2006-2009) had looked into doctoral training for the employability of doctorates through transferable skills acquisition. Building on this project, FP7 DOC-CAREERS II project aimed at widening the initial dialogue towards the broader audience of the European University Association, comprising some 850 higher education institutions, and intended to organise regional workshops to discuss how to implement in practice the project recommendations. The input provided by a large number of case studies, which was reflected in the DOC-CAREERS study, demonstrated that:

- many views on opportunities, challenges and barriers related to university-industry cooperation are shared by both partners, university and business.
- there are no "one-size-fits-all" formats for cooperation and that they tend to be strongly based in regional environments, where proximity facilitates frequent contact between stakeholders.
- the organisation of high level meetings (e.g. workshops) involving university leaders and leaders from the non-academic sector, pooling expertise from different fields and sectors, was pointed out as one way forward for improving mutual understanding and for identifying challenges which require R&D input.

Thus, through the regional focus of DOC-CAREERS II, we aimed to identify examples of university collaboration with local Small and Medium Enterprises (SMEs), large R&D enterprises, Research, Technology and Demonstration performers (RTD's), Non-Governmental Organisations (NGO's) and other organisations (health care, cultural, etc.). A series of five Regional Workshops were held in selected locations in Europe (Ireland, Switzerland, Lithuania, Norway and Italy), with the intention to bring together interested partners in cooperation through doctoral education to share and discuss specific tools and incentives that could have wider application across Europe.

The main objectives of the project were:

- To reflect on: strategies and good practices on university-industry relations; models and degree of structure of university-industry doctoral schemes; employability of doctoral holders and its relation with transferable skills; good practices in tracking of doctoral holders;

- To identify strategies and good practices used by SMEs and other local partners to approach universities and address how their access to university research could be enhanced;
- To explore the perspectives of employability of doctoral holders in the region, mobility opportunities and its relation to regional efforts to reinforce doctoral employability considering the benefits of employing highly trained workers and their professional expectations.

The employability perspectives of doctorate holders and how the collaborative nature of the doctoral programmes enhances their career perspectives remained a central focus of the project.

To be able to respond to these objectives, EUA developed an action plan in DOC-CAREERS II to involve universities with experience in the field of collaborative doctoral education that could bring further evidence on how these research collaborations work, particularly at the regional level, given the focus on regional innovation at policy level but also given the importance of this trend which emerged strongly in DOC-CAREERS.

In summary, DOC-CAREERS II focused on issues concerning career opportunities for doctoral holders in Europe. It further investigated the various models of collaborative doctoral education, employability perspectives of doctoral candidates in multiple careers and different sectors and identified regional drivers which help to take forward university-industry cooperation. The project engaged a variety of stakeholders from the non-academic sector including SME's, large R&D enterprises, RTD performers, NGO's and other service industries (health care, cultural, etc.). In this context, the project contributed to the development and improvement of institutional, regional, national and European codes of practice and, together with the outcomes of FP7 project EUIMA, will be useful to establish additional measurement tools to assist practitioners in assessing the quality of the research collaboration process. The project provided case studies demonstrating successful collaborative research projects that can be used as a framework to analyse trends regarding researchers' career paths, particularly outside academic environments, thus promoting intersectorial mobility.

Description of main S&T results/foregrounds

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1. Methodology

1.A. Focus of the DOC-CAREERS II Workshops and Case Studies - The collection of "Full Stories" and their Regional Contexts

A major change in focus from the previous DOC-CAREERS project was the selection and foci of the case studies. In DOC-CAREERS, the case studies were identified targeting specific sectors – a university, a company, a doctoral candidate or another organisation – and their selection processes were independent within a minimum set of common criteria. The selected case studies were studied sector by sector to identify both common trends and cross-cutting issues. Emerging cross-cutting indications were that i) proximity was considered an essential factor in building the necessary trust among partners; ii) the organisation of meetings involving high level academic and non-academic experts were seen as a good way to foster mutual understanding of contexts and needs and identify ideas for potential projects of common interest; iii) employability of doctorate holders were linked to mastery of some transferable skills acquired through doctoral research in cooperation with non-academic partners.

Thus, the case studies in DOC-CAREERS II aimed to deepen emerging cross-cutting issues from a regional perspective and were selected targeting the university sector, in order to study how universities work with external partners. Universities were asked to liaise with their doctoral candidates and their external partners who were involved in specific collaborative doctoral projects or programmes in order to collect "full stories", from the doctoral thesis conception to employability of the doctorate holder.

The input of the case studies was gathered either in the form of

- presentations in the workshops, and/or
- through specific questionnaires addressed to each of the three stakeholders contributing to a case study: university, doctoral candidate, business/external partner.

This means that a university which involved one of their external partners and one or more doctoral candidates enrolled in a collaborative doctoral programme filled in a university questionnaire, coordinated the collection of the university's doctoral candidate/s questionnaire responses, and gave to EUA the name and contact details of the representative in the external partner organisation to be interviewed by EUA following the business/external partner questionnaire. Universities participated voluntarily and they decided which type of input they provided to the project: i) questionnaires and workshop or ii) workshop only.

Contributions through questionnaires were encouraged by EUA because the collection of structured input offered the advantage of gathering information under the same group of questions, hence reinforcing the robustness of the outcomes of the project. A total of 13 universities, 21 doctoral candidates and 14 businesses/external partners working in collaborative doctoral projects with these universities contributed with case studies through their respective questionnaire. These universities presented their cases in at least one of the workshops, bringing with them the relevant

stakeholders (company, doctoral candidate) involved in their projects. As indicated above, additional universities which did not provide a case study through the questionnaires also presented their cases in the workshops. They focused in the guideline questions provided in the questionnaires, but in a free form. The presentations in the workshops (available at www.eua.be/doc-careersii) were used as the documentation for their case study. The two ways of providing input were considered equally important for the project and the summary of results presented in the next section on "Outcomes of the Case Studies - Workshop and Questionnaires' Results" includes both types of outcomes.

To sum up, the focus of the workshops and case studies was the collection of "full stories" from doctoral projects done in collaboration with companies or other external partners, which were put into the context of the Region in which they were developed. This focus was explicitly embedded in the DOC-CAREERS II three ad-hoc stakeholder questionnaires, the "double-acts" and "triple-acts" presentations of the case studies in the workshops, and in the contributions to the dialogue from all other participants in the workshops.

A high number of expert individuals (about 200) affiliated to 32 universities, 34 companies and 23 other stakeholder organisations, including EURODOC and Vitae, contributed to the DOC-CAREERS II project bearing in mind its focus through i) filling in their corresponding stakeholder questionnaires, and/or ii) their workshop presentations, and or iii) bringing their voice in the workshops. These individuals and organisations were from 13 different countries including Belgium, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Norway, Spain, Sweden, Switzerland and United Kingdom.

1.B. Identification and Selection of Contributing Universities

EUA published in its website and newsletter the first "Call for Expressions of Interest" at the beginning of the project to attract the participation of universities willing to convene one of the DOC-CAREERS II workshops by hosting it and identifying several local/regional case studies illustrating practice in collaborative doctoral programmes (attached – Call for Expressions of Interest I.pdf. The first call included an option for universities to contribute with a case study, without convening an event. The second "Call for Expressions of Interest", published at the beginning of the second year of the project (attached – Call for Expressions of Interest II.pdf), called for further universities interested in providing case studies. This option was important because these additional case studies were put as counter-examples to those from the host region.

According to the proposal, a series of five workshops were held across Europe and a Final Conference was held in Brussels. As indicated above, these events served as a platform for gathering good practice examples and foster discussion in collaborative doctoral education. They also aimed to test the feasibility of the organisation of regional workshops to foster university-business/external partner research collaborations and they gathered a wealth of input through the questionnaires indicated below and the presence of many stakeholders in the workshop host institutions.

The Steering Committee of DOC-CAREERS II reviewed the expressions of interest received and selected the five workshop convenors attending to the criteria of the call: i) evidence of collaborative doctoral programmes with external partners as defined in DOC-CAREERS; ii) evidence of regional interest in building a highly skilled workforce for innovation and economic growth; iii) geographical location in Europe; iv) willingness to engage in a process with EUA to define the workshop content and identify suitable case studies to achieve the objectives of the project.

All these criteria were met by the selection of universities that convened the five DOC-CAREERS II Workshops. The selection was made during the first Steering Committee meeting and the list was configured as follows (the specific dates were agreed with the host universities at a later stage):

- Workshop 1: Dublin Institute of Technology (DIT), Ireland; 21 September 2010
- Workshop 2: École Polytechnique Fédérale de Lausanne (EPFL), Switzerland ; 10 December 2010
- Workshop 3: Kaunas University of Technology, Kaunas (KUT), Lithuania; 5 April 2011
- Workshop 4: Norwegian University of Science and Technology (NTNU), Trondheim, Norway; 7 June 2011
- Workshop 5: University of Camerino (UNICAM), Italy; 11 October 2011

As a key dissemination activity of the project, a Final Conference was organised in Brussels to inform the European policy Brussels community about the outcomes of the project. This conference showcased case studies from the workshop host institutions. The presentations reflected the variety of top-down and bottom-up collaborative models, which were put in the context of the European policy development of the moment by bringing high-level representatives of DG Research (Skills Unit) and DG EAC (Marie Curie Actions Unit).

The DOC-CAREERS II Final Conference was held at the Royal Flemish Academy of Belgium for Sciences and the Arts (Brussels) on the 30-31 January 2012.

1.C. DOC-CAREERS II Workshops - Preparation and Roles of the Host University and EUA

The process to prepare a workshop was developed in partnership with the Host University. A convenient procedure was set as follows:

Step 1. Initial meeting between EUA DOC-CAREERS II team and a high-level representative from the host university responsible for the organisation of the workshop. The objective was to exchange information on the objectives of the project, clarify questions from the expression of interest submitted by the host institution and define the date of the workshop.

Step 2. Identification of case studies. From the part of the Host University (DIT, EPFL, KUT, NTNU, UNICAM), this was done at their local/regional level. From the part of EUA, this was done through the Calls for Expressions of Interests indicated above. The objective was to identify "full story" case studies, that is, a doctoral supervisor, a doctoral candidate and a company representative that would exemplify good collaboration in doctoral education.

Step 3. Definition of the programme. This was done jointly by the Host University and EUA once the case studies were clearly identified. The outline of the programme was then established considering the number and characteristics of the case studies (which defined the number and content of the parallel sessions), the host university regional approach (city, region and/or country), and the overall line of development of the project.

In parallel, the Host University would identify the venue and meeting rooms according to the programme and make the necessary contacts with the University and regional authorities.

Step 4. Distribution of DOC-CAREERS II Questionnaires. As it will be described in Section 1.F, the questionnaires developed by EUA aimed at providing structured input. These were distributed to the university doctoral supervisors, doctoral candidates and company representatives identified by both the Host University and by EUA.

Step 5. Written Communication from EUA in the form of an e-mail including a personalised invitation to all identified speakers, including a briefing document informing them about the objectives of the workshop and their expected contribution. E-mails were sent by EUA with copy to the main person in charge of the organisation of the workshop at the University. This was particularly important for the company representatives who were normally reluctant to attend the workshop and often questioned their role in them.

Step 6. Oral Communication through phone conversations by EUA with each of the speakers of the workshops before the event, to ensure an understanding of the workshop objectives and the place of the workshop in contributing to the overall objectives of the project. This was important for all involved but particularly for doctoral candidates and industry representatives, because their interpretations from the written documents were varied and not always in alignment with the concept of the project. We had to bear in mind constantly that we were dealing with people from many countries and regions in Europe, for whom the same words might have different meanings or connotations.

Step 7. Preparation by EUA of a "Description of the Workshop" document, which was distributed to all workshop participants about one week before the event. The descriptions of the workshop included: the programme, the list of participants, a summary of the project context, objectives and activities, a description of the host university and its interest in the workshop, a list of key questions for the debate and a list of expected outcomes.

As a part of the preparation of the Final Conference, EUA requested each of the Host Universities to indicate the benefits and added value of the organisation of their workshops. A list, aggregating all the points mentioned by the Host Universities is provided in Section 3.

1.D. DOC-CAREERS II Workshops - Programme Structure and Key Characteristics

A unique characteristic of the DOC-CAREERS II workshops was that universities presenting their case studies reflected the "full story" approach (indicated above) by being accompanied by their business/external partners and/or the doctoral candidates enrolled in collaborative programmes. Thus, presentations of case studies had the format of "double acts" (university-doctoral candidate or

university-business/external partner) or “triple acts” (university-doctoral candidate-business/external partner).

Another particular characteristic of DOC-CAREERS II workshops was their structure, which was carefully tested and reviewed to achieve maximum outcomes out of one-day activity. It included one specific high level expert part (6-7 hours long), with extensive time for interactive discussion for in-depth dialogue amongst high-level invited experts, and another open part (1.5 hours) aimed at dissemination and communication to a broader audience including high-level representatives of the region and abroad. The structure of the workshops and type of participants proposed in the project proposal were validated by the Steering Committee, adjusted from the First to the Second Workshop and consolidated after the Second DOC-CAREERS II Workshop held in EPFL, Switzerland. The definitive structure of the workshop programmes was as follows:

1) The Specific Part (approximately 6-7 h long, e.g. from 8:30 to 15:00) would include one initial Plenary Session to set the regional context, the university context and the objectives of the project. This session was followed by one set of parallel sessions preceded by a coffee break and followed by a lunch break. After this, one-hour final discussion session would give to the participants a 6-8 min report of the outcomes of parallel sessions and allow a plenary discussion of 30-45 minutes duration, thus allowing input from all participants. The Specific Part of the workshop was limited to 40 to 50 invited experts (including speakers and audience). While this number may look small, it is really important to foster high quality dialogue involving all participants and particularly those coming from industry, who are more readily to open up and be more vocal in small groups.

Targeted participants for the specific part were researchers and professors with doctoral supervisory roles, representatives from companies, research institutes or other research external partners, higher education policy representatives, doctoral candidates, representatives from professional bodies, etc.

2) The Final Session Open to Stakeholders (approximately 1 ½ h long, normally from 15:30 to 17:00) aimed to address general issues related to doctoral education in general and employability of doctorate holders in the region. The audience was composed mainly by university students and professors but also involved higher education policy representatives, representatives from industry and other professional bodies. It also broadened the scope of the workshop with contributions of high-level speakers that highlighted the added value that doctorates bring to regional development and company development when the organisations put value in innovation through R&I. The size of the audience in the open sessions was 70-120 people.

All workshops included a dinner the evening before to allow speakers and participants to meet, many for the first time, in an informal ambiance to facilitate dialogue the day after.

Overall, the five DOC-CAREERS II workshops held a common line and reflected a holistic approach to collaborative doctoral education. Their key characteristics can be summarised as follows:

- **Regional:** Incorporated the **local/regional dimension** in which the university operates, by identifying case studies illustrating practice in the region and by contextualising this activity in the overall role of the university doctoral education in the economy and development plans of the region. This was done in the workshop introductory plenary. EUA allowed every host university to

define the remit of their "region". This proved to be very good because, across the five workshops, several regional concepts were shown through the doctoral practice:

DIT: Local Dublin and Ireland

EPFL: Local Lausanne with a high component of world-wide reach-out

KUT: Local Kaunas and Lithuania

NTNU: Local Trondheim and Norway

UNICAM: Marche Region

- **European:** Incorporated at least one external case study as counter-example to the locally provided case studies. This was done in the workshop parallel sessions and was used as a tool for reflection on common and distinctive elements from a regional perspective. EUA ensured that the expert workshop audiences had a minimum proportion of non-national/non-regional participants (at least 15%) to foster dialogue at both regional and European level.

DIT: 58% region/country Ireland – 42% non-Irish

EPFL: 40% region/country Switzerland – 60% non-Swiss

KUT: 60% region/country Lithuania – 40% non-Lithuanians

NTNU: 50% region/country Norway – 50% non-Norwegians

UNICAM: 60% region/country Italy – 40% non-Italians

- **Intersectorial/Multi-stakeholder:** Incorporated the **views of the three main stakeholders** involved in a collaborative doctoral thesis: university supervisor, doctoral candidate, company supervisor, in the form of "double acts" or "triple acts". The three voices were welcomed in the workshops on an equal basis. In addition, the **broad range of sectors** invited in the expert sessions included higher education policy makers, representatives from research and technology organisations, representatives from university networks, representatives from professional bodies, heads of doctoral schools, health authorities, policy authorities.

DIT: 67% university sector, 11% industry sector, 22% other in the higher education and research sector

EPFL: 58% university sector, 18% industry sector, 24% others in the higher education and research sector

KUT: 65% university sector, 5% industry sector, 30% others in the higher education and research sector

NTNU: 59% university sector, 16% industry sector, 24% others in the higher education and research sector

UNICAM: 60% university sector, 16% industry sector, 24% others in the higher education and research sector

- **Multidisciplinary:** the workshops and case studies covered many different areas within the broad fields of Science, Engineering and Technology (SET), Biotechnology, Medical and Life Sciences (BML) and Economics, Social Sciences and Humanities (ESSH). Although there were more cases from the first two than from the third, ESSH-related case studies were present in DIT, KUT, NTNU

and UNICAM Workshops. This was proven also to contribute to the enrichment of the dialogue amongst professionals from very different disciplines.

DIT: environmental health, nutrition, engineering, migration and communication, bioprocesses, creative arts and media

EPFL:engineering, healthcare, materials manufacturing and consulting

KUT:energy, health, engineering and business and management

NTNU:international project management, petroleum geophysics, renewable electrical energy, and perceptual and brain sciences

UNICAM:engineering, materials, health (malaria) and security

- **High-level and experienced practitioners as participants:** workshops always involved the active presence of the Rector of the host university (DIT: Prof. Brian Norton; EPFL: Patrik Aebischer; KUT: Prof. Eugenijus Uspuras; NTNU: Prof. Torbjørn Digernes; UNICAM: Prof. Fulvio Esposito) and the presence of vice-rectors and directors of the doctoral school, one or more high-level authority from the region/country, and top representatives from major stakeholder networks in the field (Dr. Leopold Demiddeleer, EIRMA; Prof. Jean Chambaz, Chair of EUA-CDE, Dr. Janet Metcalfe, Vitae). Please see attached document Overall description of DOC-CAREERS II Workshops.pdf for the full detailed list of high-level representatives in the workshops.

Very importantly, the host organisations designated high-level and competent individuals to organise the workshops. All of them held a role in their respective institutions Rector's offices: Prof. Mary McNamara, DIT; Dr. Verity Elston, EPFL; Vice-rector Rymantas Kazys, KUT; Dr. Raghild Lofthus, NTNU; Prof. Cristina Miceli, UNICAM. Their dedication and efforts in selecting the case studies and the representatives that could describe them accurately according to the objectives of the project were key to the success of the workshops.

- **Optimal number of participants with extensive time for discussions: Active Focused Dialogue and Open Dissemination:** Extended time for discussion allowed focused, in-depth discussions with the active participation of all workshop participants. . Involving high-level participants and creating an environment where people felt confident and could speak freely was extremely important.

DIT: 45 experts from 11 different European countries

EPFL: 33 experts from 9 European countries

KUT: 40 experts from 9 European countries

NTNU: 50 experts from 9 European countries

UNICAM: 55 experts from 10 European countries

- **Open:** The widening of the dialogue during the open session raised awareness of collaborative doctoral education to an audience composed mainly of university students and professors, but also involving higher education policy representatives, representatives from industry and other professional bodies. It also broadened the scope of the workshop with contributions by high-level speakers that highlighted the added value that doctorates bring to regional development and

company development when the organisations put value in innovation through R&I. Top level representatives addressed these sessions, such as Prof. Patrick Aebischer, President, EPFL or Dr. Nerija Putinaite, Vice-minister of Education and Science, Lithuania (see attached document Overall description of DOC-CAREERS II Workshops.pdf for full list of representatives in the Final Open Sessions).

- **Focused:** Every workshop had outlined clear questions for discussions and their related objectives or expected outcomes, aligned with the main objectives of the project (see attached document Overall description of DOC-CAREERS II Workshops.pdf for a fully detailed list of questions). The three ad-hoc stakeholder questionnaires that will be described below were used as the framework to develop the main subjects for discussion in each workshop.

In summary, the five workshops conducted in the DOC-CAREERS II project addressed the following main subjects:

- i) how universities and companies/external partners set objectives of mutual benefit for the university and the business in which a doctoral candidate can develop his/her skills as a researcher;
- ii) how the doctoral process is monitored by both parties;
- iii) how universities and companies recruit doctoral candidates and how companies recruit doctorate holders, and
- iv) how intellectual property rights are managed in doctoral education in cooperation with industry and other external partners (particularly in workshops 4 and 5)
- v) policy contexts and their characteristics which may foster on hinder collaborative research.

1.E. The DOC-CAREERS II Final Conference in Brussels

The final conference of DOC-CAREERS II was held in The Royal Flemish Academy of Belgium for Science and the Arts (KVAB), in Brussels, on 30-31 January 2012.

The successful final conference of DOC-CAREERS II presented the main outcomes of the project and the highlights of the series of five regional workshops. This conference gathered over 120 experts from 25 countries and participants included university leaders and researchers (vice-rectors of research or postgraduate education, directors of doctoral schools, directors of doctoral programmes, university thesis supervisors, researchers and doctoral candidates), company leaders (CEOs, vice-presidents of research, researchers), Non-Governmental Organisation (NGO) representatives, employers interested in collaborative doctoral education, and senior policy makers from regional, national and European bodies. Speakers included experts from the different sectors involved in collaborative doctoral education: 10 university leaders; 7 company leaders and other external partners; 4 former doctoral candidates enrolled in collaborative doctoral programmes now working in non-academic positions; the European Commission and other stakeholder organisations including EURODOC (European Council of Doctoral Candidates and Junior Researchers); EIRMA (European Industrial Research Management Association), and Vitae UK.

The DOC-CAREERS II Final Conference was structured in four Plenary Sessions:

Two Plenary sessions showed the typical “double act” and “triple act” presentations as in the workshops. They highlighted key elements of success in collaborative doctoral education.

Another Plenary discussed the views, interests and experiences of the three main stakeholders on Intellectual Property Rights issues: from academic, industry and doctoral candidate/holder perspectives.

Plenary 4 presented a pan-European new initiative on collaborative doctoral education developed by participant organisations in DOC-CAREERS II, particularly by three universities that had followed the project very closely. The initiative was called “The European Industrial Doctoral School” and, at the time, it was being established by Umeå University, Sweden; Bangor University, UK; and Ghent University, Belgium. Plenary 4 also included a fruitful dialogue with European policy makers and stakeholders: DG EAC, the SG HRM and EURODOC, where the Principles for Innovative Doctoral Training were presented by Peter Van der Hijden from the European Commission. Alessandra Luchetti, Head of Unit of the Marie Curie Actions Unit at DG EAC, contributed with an update on the new developments under the new scheme in preparation, the Marie Skłodowska Curie programme.

A Round-Up Session put an end to the conference with the views and experiences of two of the DOC-CAREERS II Steering Committee members that were also involved in the DOC-CAREERS project as contributors of case studies.

Conference sessions reviewed models of doctoral programmes in collaboration with different partners - including large companies, small and medium size companies (SMEs), and public health authorities. The conference addressed the following four main topics:

- i) Elements of success in collaborative doctoral education
- ii) Intellectual property rights
- iii) Embedding employability perspectives
- iv) European added-value initiatives and dialogue with policy makers

As in all the preceding regional workshops, presentations took the form of “**double acts**” (academia-industry) or “**triple acts**” (academia-industry-doctorate candidate/holder) offering views and experiences in collaborative doctoral education. A special session on intellectual property rights was also organised to deepen the understanding of how this important issue is dealt with in collaborative doctoral research.

1.F. DOC-CAREERS II Questionnaires: universities, doctoral candidates, businesses/external partners

As indicated above, the questionnaires were prepared to collect structured input from participants and they were used as a framework to prepare the key questions for discussion in the workshops and final conference. They were, therefore, an important and integral part of the project. The questionnaires included specific questions on setting up and taking forward research collaborations

with a particular focus on doctoral education. Three questionnaires were prepared including specific questions to each of the three stakeholders: university professors acting as doctoral supervisors, doctoral candidates and companies or other external partners. They were developed based on the questionnaires from DOC-CAREERS, which were updated according to the outcomes of the project. Their main characteristics were as follows:

DOC-CAREERS II Questionnaire for Universities on Doctoral Programmes in Cooperation with Business/External Partners: A total of 13 universities contributed with case studies, covering 18 doctoral programmes. The questionnaires included specific questions on setting up and taking forward research collaborations with a particular focus on doctoral education. The questionnaire for universities was composed of 45 questions structured in six parts, namely: i) institutional data; ii) general data of the doctoral scheme; iii) employment outcomes of the doctoral scheme; iv) the university-business partnership: the process of setting up the doctoral scheme; v) the university-business partnership: main characteristics of the doctoral scheme; vi) impact of the doctoral scheme and lessons learned.

DOC-CAREERS II Questionnaire for Doctoral Candidates enrolled in Doctoral Programmes in Cooperation with Business/External Partners: A total of 21 doctoral candidates with experience in collaborative doctorates responded to their ad-hoc questionnaire. These were people enrolled or that had been recently enrolled as doctoral candidates in of the 13 universities above mentioned and that were involved in a collaborative doctoral project.

The questionnaire for doctoral candidates was composed of 29 questions structured in three parts, namely: i) researcher data; ii) general data of the doctoral scheme; iii) impact of the doctoral scheme.

DOC-CAREERS II Questionnaire for Businesses/External Partners participating in doctoral collaborations with industry or with an interest for it: A total of 14 companies agreed to take part in this consultation. These companies were identified by the participant universities (as one of their external research partners) and by EIRMA, the European Industrial Research Management Association, (which was one of the organisations in the Steering Committee of DOC-CAREERS II). The consultation took the form of site visits or 30-minute-phone interviews following the business/external partner questionnaire which was composed of 48 questions structured in three parts, namely: i) general information; ii) experience with specific doctoral training schemes ; iii) general lessons learned.

Due to the sensitive character of many questions in the questionnaires, EUA committed to keep confidentiality of the written information.

2. List of contributing organisations: universities, companies and other stakeholders in the field

The following list includes the organisations that were actively involved in the DOC-CAREERS II project. These organisations are classified in three categories: higher education institutions, companies, and other organisations. All the organisations listed contributed valuably to the outcomes of the events they were part of by providing their views based on their experiences.

The roles of the organisations in the DOC-CAREERS II project – Workshop Participant, Case Study provider, or Steering Committee member – are shown in brackets.

Higher Education Institutions

1. Ghent University, Belgium (University Case Study, 6 Doctoral Candidates Case Studies, Workshop Participant)
2. Hanken School of Economics, Finland (Workshop Participant)
3. University Pierre and Marie Curie, France (Workshop Participant)
4. Ingolstadt University of Applied Research, Germany (University Case Study)
5. University of Paderborn, Germany (Workshop Participant, Steering Committee)
6. Dublin Institute of Technology, Ireland (University Case Study, Workshop Participant)
7. National University of Ireland, Galway, Ireland (Workshop Participant)
8. University College Cork, Ireland (Workshop Participant)
9. University College Dublin, Ireland (Workshop Participant)
10. Polytechnic University of Marche, Italy (Workshop Participant)
11. Polytechnic University of Milan, Italy (Workshop Participant)
12. University of Camerino, Italy (University Case Study, Workshop Participant)
13. University of Chieti-Pescara, Italy (Workshop Participant)
14. University of Ferrara, Italy (University Case Study, Workshop Participant)
15. University of Perugia, Italy (University Case Study, 1 Doctoral Candidate Case Study, Workshop Participant)
16. Kaunas University of Technology, Lithuania (University Case Study, Workshop Participant, Steering Committee)
17. Klaipeda University, Lithuania (Workshop Participant)
18. Lithuanian University of Agriculture, Lithuania (Workshop Participant)
19. Lithuanian University of Health Sciences, Lithuania (Workshop Participant)
20. Mikolas Romeris University, Lithuania (Workshop Participant)
21. Siauliai University, Lithuania (Workshop Participant)
22. Vilnius Gediminas Technical University, Lithuania (Workshop Participant)
23. Norwegian University of Science and Technology, Norway (University Case Study, 5 Doctoral Candidates Case Studies, Workshop Participant)
24. Pompeu Fabra University, Spain (Workshop Participant, Steering Committee)
25. University Rovirai Virgili, Spain (Workshop Participant)
26. Umeå University, Sweden (University Case Study, 3 Doctoral Candidates Case Studies Workshop Participant)
27. École Polytechnique Fédérale de Lausanne, Switzerland (University Case Study, Workshop Participant)
28. Swiss Federal Institute of Technology Zurich (ETH), Switzerland (Workshop Participant)
29. Bangor University, United Kingdom (University Case Study, Workshop Participant, Steering Committee)

30. Newcastle University, United Kingdom (University Case Study, 3 Doctoral Candidates Case Studies, Workshop Participant)
31. University College London, United Kingdom (University Case Study, 3 Doctoral Candidates Case Studies, Workshop Participant)
32. University of Ulster, United Kingdom (Workshop Participant)

Companies

1. Alcatel Lucent, Belgium (Company Case Study)
2. Applied Maths. Belgium (Workshop Participant)
3. Solvay S.A. Research and Technology, Belgium (Workshop Participant, Company Case Study, Steering Committee)
4. GlaxoSmithKline Biologicals (GSK Biologicals), Belgium (Company Case Study)
5. Jansen Pharmaceutica, Belgium (Company Case Study)
6. OCAS, Belgium (Company Case Study)
7. Umicore, Belgium (Company Case Study)
8. Genes Diffusion, France (Workshop Participant)
9. Schlumberger, France (Company Case Study)
10. Biotalentum, Hungary (Company Case Study)
11. Intel, Ireland (Company Case Study)
12. Advanced TechnologieBiomagnetics.r.l., Italy (Workshop Participant)
13. Aptuit, Italy (Workshop Participant)
14. Finmeccanica, Italy (Workshop Participant)
15. Goldenplasts.p.a., Italy (Workshop Participant)
16. iGuzziniIlluminazioni.p.a., Italy (Workshop Participant)
17. SINERGO s.r.l., Italy (Workshop Participant)
18. Comfort Heat UAB, Lithuania (Workshop Participant)
19. Lithuanian Energy Institute, Lithuania (Workshop Participant)
20. UAB "NaujasNevezis", Lithuania (Workshop Participant)
21. DNV, Norway (Workshop Participant)
22. FarsundAluminium Casting, Norway (Company Case Study, Workshop Participant)
23. NTE, Norway (Workshop Participant)
24. Ortivio, Norway (Company Case Study)
25. Scandinavian Business Seating, Norway (Company Case Study)
26. SINTEF, Norway (Workshop Participant)
27. Skretting, Norway (Company Case Study)
28. Statoil, Norway (Workshop Participant)
29. DomsjöFabriker AB, Sweden (Workshop Participant)

30. Oryx Simulations AB, Sweden (Company Case Study)
31. Debiotech SA, Switzerland (Workshop Participant)
32. HelbingTechnik Bern AG, Switzerland (Workshop Participant)
33. Rolex SA, Switzerland (Workshop Participant)
34. Sonceboz Automotive SA, Switzerland (Workshop Participant)

Other organisations

1. EURODOC, Belgium (Workshop Participant)
2. European Commission, DG Education and Culture, Marie Curie Actions Unit, Belgium (Final Conference Participant)
3. European Commission, DG Research, Belgium (Workshop Participant, Steering Committee)
4. European Industrial Research Management Association, Belgium (Workshop Participant, Steering Committee)
5. European University Association, Belgium (Workshop Participant, Steering Committee)
6. Dublin City Council, Ireland (Workshop Participant)
7. Health Service Executive, Ireland (Workshop Participant)
8. Higher Education Authority, Ireland (Workshop Participant)
9. Irish Universities Association, Ireland (Workshop Participant)
10. Confindustria Young Entrepreneurs, Italy (Workshop Participant)
11. Council for Industrial Development, Marche region, Italy (Workshop Participant)
12. Italian Ministry of Education University and Research, Italy (Workshop Participant)
13. Ministry of Education and Science, Lithuania (Workshop Participant)
14. Association of Doctoral Organisations in Norway, Norway (Workshop Participant)
15. NIFU STEP – Studies in Innovation, Research and Education, Norway (Workshop Participant)
16. Nordic Institute for Studies in Innovation, Education and Research, Norway (Workshop Participant)
17. Research Council of Norway, Norway (Workshop Participant)
18. The Association of Norwegian Research Institutes, Norway (Workshop Participant)
19. The Norwegian Association of Higher Education Institutions, Norway (Workshop Participant)
20. Fundación Universidad-Empresa, Spain (Workshop Participant)
21. Rectors' Conference of the Swiss Universities, Switzerland (Workshop Participant)
22. World Health Organisation, Switzerland (Workshop Participant)
23. Vitae, United Kingdom (Workshop Participant)

The following countries were represented in the Workshops and in the Final Conference:

1. Belgium
2. Finland
3. France
4. Germany
5. Hungary
6. Ireland
7. Italy
8. Lithuania
9. Norway
10. Spain
11. Sweden
12. Switzerland
13. United Kingdom

3. Benefits and measures of success of Workshops and Final Conference

During the regional workshops, speakers explained their views, experiences, concerns and solutions related to collaborative doctoral education projects. The importance of the experience of doctoral candidates bridging the university and business environments was the central focus of the discussions. Particular attention was paid to bring to light those issues which were dealt in the specific framework of the region that could be of wider potential application in other contexts, particularly regarding the involvement of SMEs. Within the framework of collaborative doctoral education, the five workshops focused mainly on:

- Models of collaborative research programmes
- Employability of doctorate holders
- Intersectorial mobility
- Doctoral supervision and monitoring
- Involvement of SMEs
- Contractual matters: Intellectual Property Issues, working conditions, time sharing between the university and the company, etc.
- Key factors of success
- How to foster collaborative research partnerships
- Policy initiatives and environments and their importance in fostering or hindering university-business collaborations

The specific objectives and questions that were addressed in every workshop can be found in the summary Workshop Descriptions (attachment Overall description of DOC-CAREERS II workshops.pdf). Photos of the workshops and Final Conference can be found in the attached document DOC-CAREERS II Workshops and Final Conference photos.pdf. Presentations given in the workshops and final conference are public in the website of DOC-CAREERS II project:

www.eua.be/doc-careersii. The outcomes of each discussion session were reported in the corresponding workshop Deliverable: DIT (D2.1), EPFL (D2.2), KUT (D3.3), NTNU (D2.4), UNICAM (D2.5).

The overall outcomes of the discussions across the five workshops and Final Conference were summarised jointly with the responses of the stakeholders to the DOC-CAREERS II questionnaires and are reported in Section 4.

In the paragraphs that follow, a series of indicators that assess, qualitatively, the benefits of the DOC-CAREERS II workshops are given. As described in Section 1, the workshops were characterised by a series of elements which were the result of their careful preparation (Regional, European, Intersectoral/Multi-stakeholder, Multidisciplinary, High-level, Small in size and extensive time for discussions, Open, Focused and Holistic approach). A shared common approach and major commitment from host universities ensured major benefits. These benefits accumulated over time as the series of workshops evolved.

Measuring the success of the DOC-CAREERS II workshops

- **Major engagement of industry and external partners:** One of the key measures of success of the structure implemented in the DOC-CAREERS II workshops was the high attendance by company representatives involved in collaborative doctoral education (11%-18% company representatives per workshop). The business participation rate in all the workshops was very high in relation to many existing university-business workshops which mainly involve university representatives. The key for this successful rate of company representatives attendance was the condition pursued by EUA that participant universities had to commit to involve their external partners in providing their input. This was hard work for both the universities and EUA. Teamwork was essential in achieving a successful approach to companies and external partners, as described earlier in Section 1.C on “DOC-CAREERS II Workshops – Preparation and Role of the Host University and EUA”.

In addition, EUA worked in collaboration with EIRMA, an organisation that since 2007 welcomed this type of high-level encounters between university and industry managed by EUA. They were already engaged in DOC-CAREERS project. EIRMA engaged again some of their companies as providers of case studies and its President as a member of the DOC-CAREERS II Steering Committee.

- **High-quality and depth of dialogue:** The double-acts and triple-acts and the extended time for discussion allowed to enormously enrich the quality and depth of dialogue, in contrast with events in which the presence of the business sector is minimal or non-existent. Extensive dialogue took place in the parallel sessions, where the case studies were presented and discussed in detail, and in the Final Discussion Session gathering all experts in a final discussion plenary. Discussions paid particular attention to the specifics of the doctoral candidate education and follow-up, his/her mobility opportunities and the benefits and challenges for the university and the company.

- **Long permanence and presence of stakeholders in the workshop:** Thanks to the short duration of the workshop (6-7 hours), most participants could afford to stay for the whole event. This was particularly important for the business representatives who normally not only stayed and listened to all presentations, but were also very vocal during the discussions.
- **High-level participants from university and business sectors:** Workshops involved the representation and addressees of universities at its highest level (Rector) and CEOs of partner companies and other actors in the field which included ministries of education or science and/or local authorities interested in building a strong base of highly educated people to work in the region, as a way to foster innovation through R&I.
- **Dialogue local/regional - European:** The introduction of non-local case studies (such as the Umeå case study in the EPFL workshop or that of University College London in Camerino), together with the presence of an international audience, allowed interesting discussions on the different contexts in which the doctoral collaborations take place. While there is a backbone common to these collaborations (identified in DOC-CAREERS) that can be translated from one context to another, negotiating conditions (including working conditions, IP, etc.) and details must be dealt with on a case-by-case basis, and these may not be transferable, as they normally depend on the national context and on laws applying to universities or companies. Moreover, the language of the negotiations is normally the local language: this was particularly apparent in the workshops of Camerino (Italian in Italy), Trondheim (Norwegian in Norway) and Kaunas (Lithuanian in Lithuania).
- **Showcase of a broad range of successful models of cooperation** in doctoral education: "top-down" (such as that from the KESS initiative from Bangor, using Structural Funds or the doctorates funded by the Research Council of Norway) and "bottom-up" (such as the case of Kaunas University of Technology with local companies, one of them a SME which involved a former student that was already working in the company when she engaged in the doctorate).
- **Loyal expert audience:** A group of experts from across Europe attended the five workshops and Final Conference, thus following the project from beginning to end.
- **Platform for new initiatives:** Out of this loyal community of experts, three universities decided to invest further in developing a common industrial graduate school (University of Ghent, Umeå University and Bangor University). They used the DOC-CAREERS II workshops for their continued meetings and this process is now being consolidated.

- **Views from workshop organisers** all agreed that the organisation of their workshop was a great success in their university. In their feedback to EUA, they indicated a series of benefits that illustrate this success:
 - Promoted unique collaborative doctoral education partnerships
 - Improved regional, interregional and national cooperation
 - Promoted collaborative doctorates and doctoral degrees
 - Good platform for participation of SMEs
 - Enhanced European networking
 - Highlighted main approaches and solutions to problems in university/business cooperation
 - Shared knowledge between actors from different sectors
 - Assisted in developing network
 - Assisted in building consortia for application for funding
 - Allowed to increase community awareness of university activities

Overall, the combination of elements across the five workshops gave a multi-dimensional and holistic characteristic to the DOC-CAREERS II project, ranging from the individual development of researchers to regional and European competitiveness and European policy for the education and career prospects of researchers.

This list of elements featured here can be used to start defining a series of measurement factors to assist practitioners in assessing the quality of the interaction between university and businesses when defining strategies to start or improve their chances for collaboration

4. Outcomes of the Case Studies (Workshop and Questionnaires' Results)

Objectives

The DOC-CAREERS II project aimed to achieve three main objectives. First, the project sought to disseminate the outcomes of DOC-CAREERS in a broader range of university partnerships with non-academic organisations. The project also aimed to identify models of interaction of universities with their regional partners in doctoral education. In this respect, the project focused on: strategies and good practices used by SMEs and other local partners to approach universities; how to enhance the access of non-academic organisations to university research; bringing into the dialogue SMEs that appreciate the added value and benefits of university-industry cooperation in order to identify issues which could be addressed at local level. On focusing on the relationship between universities and businesses, the project also considered the skills acquired in collaborative doctoral schemes, the perspectives of employability of doctoral holders at the regional level, and mobility opportunities and their relation to regional efforts to reinforce doctoral employability. The third and final objective

of DOC-CAREERS II was to explore how to provide regular assistance in fostering university-industry collaboration at the doctoral level, in particular with the EUA-CDE, with the other three partners of the Responsible Partnering Initiative and with regional bodies, both private and public.

The case studies conducted in DOC-CAREERS II aimed at providing a “full story” encompassing the views of an academic leader (e.g. thesis supervisor, director of doctoral programme) involved in collaborative doctoral education, of one or more of his/her supervised doctorate candidates/holders and of one or several of the companies/external partners with whom the academic leader works in research collaborations.

In order to collect structured input from these stakeholders, in-depth questionnaires covering a wide range of areas were used. The main topics addressed in the questionnaires related to the motivations and incentives to engage in a collaborative scheme; the main characteristics of the scheme (including funding and IPR arrangements); recommendations and good practice examples; specificities of the collaborative schemes across different fields of knowledge (SET, BML, ESSH); the importance of transferable skills for increased employability of doctoral candidates; and the main benefits and sustainability of collaborative doctoral schemes.

The questionnaires were submitted by 13 universities, representing 18 doctoral programmes, 14 companies and 21 doctoral candidates. The main trends identified in the analysis of the case studies can be summarized as follows:

4.A. Motivations to engage in the collaborative doctoral scheme

The increasing degree of complexity and the fast changing pace of the challenges faced by modern societies and, in particular, by the business and the university sectors, spans across several dimensions – technological, economic and social –, and creating solutions to tackle them requires knowledge and skills that cross-cut functional areas of knowledge and sectorial activity. This overall context is reflected in the development strategies pursued by universities and by industry. As indicated by both sectors, the main motivation to engage in partnerships and, specifically, in collaborative doctoral degrees, is to further their competitive advantage and foster innovation.

The specific regional and national characteristics, articulated with national-level policies and strategic development priorities, are also important contextual variables that help understand the emergence and deepening of university-industry collaboration. In this respect, the outcomes of both case studies and workshops have shown that, in some cases, university-industry partnerships emerged as a result of national or regional strategies/legislation or due to the regional/geographical proximity between industry and universities, which acted as a catalyst of inter-sectorial cooperation.

According to the views of the university sector gathered in the workshops and case studies, research and innovation are perceived as essential pillars of development, and these allow universities to better tackle the societal challenges and, therefore, to support regional and national development. Interacting with industry partners, namely via the establishment of collaborative doctoral schemes, is an important strategic activity for universities, as it pushes forward the development of interdisciplinary training and provides solutions for complex problems, responding to industry needs.

Advancing research, namely through cooperation with the business sector, also gives universities more visibility, nationally and internationally, and allows them to have access to a wider pool of funding sources (with the industry partner, international funding). Cooperation with the business sector also allows universities to strengthen the perceived value of research. Other motivations to cooperate with the business sector include: responding to skill shortages identified at the regional/national level or by the business sector; improving the quality of doctoral programmes developed at the university; offering the opportunity to develop research applied to industrial problems; having more interdisciplinary training; or seeking strategic changes in the university's mission.

For companies, collaboration with the university allows the possibility to have a highly skilled workforce and to develop cutting-edge scientific and technical knowledge to solve the challenges posed to the sector. It also provides access to the university world. In some cases, close ties between the company and the university is perceived as an integral part of the industry's strategy in order for it to remain competitive. It is important to highlight that collaborative doctoral training is beneficial for all knowledge-based companies, irrespective of their size, i.e., be they large companies or Small and Medium Enterprises (SMEs). In the same vein, collaborative doctoral schemes are also beneficial for the public sector, as it allows public authorities to access high level knowledge and skills, which are typically difficult or impossible to find in-house.

Selected quotes from participants:

Dublin Institute of Technology: *"Close engagement locally and globally with society and the economy, and collaborative links with a range of world-class companies and academic institutions internationally are essential components in everything DIT does"*

UNICAM Chemical: *"GoldenPlast (...) is located in a small town on the Adriatic coast, in the centre of the Marche footwear industrial park (...) GoldenPlast feels the responsibility to remain competitive and keep growing. It is no longer possible to much count on suppliers and competitors to obtain information, but it is absolutely necessary to acquire proprietary scientific knowledge and professional wisdom. As a consequence, GoldenPlast has felt the need to draw the attention of UNICAM on its activities and decided to start a co-operation based on a doctorate".*

University of Ferrara: *"The doctoral scheme is pursued within the region Emilia Romagna and in close proximity of other main productive regions such as Lombardia and Veneto. There are close relations between the companies based in these regions and our university (...) Thus, research programmes are calibrated in relation to the possible need of external recipients of the research and of the doctorates"*

Kaunas University of Technology: *"An innovation-oriented university (...) responsive to the needs of the national economy and the international research market (...) a university which is a partner of industry, business, NGOs, and the society"*

Intel Ireland: *"We would like to develop a Strategy Research Programme – partnerships with the Universities are the best for that"*

4.B. Advantages of the collaborative scheme

As indicated by all stakeholders across the workshops and case studies, the major benefit of the collaborative doctoral scheme, compared to a traditional doctoral programme, is the need of the doctoral candidate to bridge and integrate both sectors – the university and industry. This aspect was perceived simultaneously as the main advantage and the main challenge in pursuing a collaborative doctoral degree. All stakeholders, but especially doctoral candidates, need to balance the different needs and demands of the university and the industry partner arising in the collaboration process. In spite of being perceived, partly, as a challenge, it is exactly this factor that underpins the perception that doctorate holders from a collaborative scheme are more employable in the industry sector than doctorate holders from traditional programmes.

Another advantage of collaborative schemes, as indicated by the stakeholders, is the possibility for doctoral candidates to work in interdisciplinary areas that extend beyond their specific area of expertise. Relatedly, the involvement of doctoral candidates in applied research and the opportunity to undertake research projects relevant for both the academic and the industry partner, gaining a broader perspective of the research topic considered, were also considered as relevant advantages. This involves a deeper understanding of the goals and challenges faced by both sectors and the emergence of joint solutions that satisfy the different partners' needs and demands. The collaborative doctoral training was also perceived as helping to ensure effective funding, as the clear definition of roles and expectations of the parties help to prevent a gap between expected outcomes and actual results.

On a more concrete level, universities, businesses and doctoral candidates also considered that undertaking a collaborative degree entails the acquisition of important transferable skills relevant for both the university and the business sectors. These refer mainly to organisational and management skills, entrepreneurship, leadership and business skills, and communication skills (e.g., being able to present research outcomes to both an academic and a business-related audience). Career guidance provided by industry mentors, the development of a network of contacts between the university and the business and the possibility for doctoral candidates to attend training organised by the company were also pointed out as distinctive advantages of the collaborative scheme.

Other advantages highlighted by the universities and companies, referred to the consequences of the cooperation, namely the increase in innovation, the wider applicability of research results and the incorporation of industry input in the research conducted in academia, which is beneficial for both parties. The collaboration was also seen as an important opportunity to change stereotypes about university-business cooperation.

Selected quotes from participants:

NTNU: *"One of the assumptions behind establishing such a scheme is that candidates in these projects will develop unique competence and skills and be "bilingual" in terms of understanding the "languages" of both academic and non-academic sectors".*

Ghent University: *"For the PhD candidates it is often a way to develop themselves as researchers without losing touch with the private sector (...) For the companies it is an opportunity to introduce more fundamental research in their work"*

University of Perugia: *"This doctoral scheme allows [doctoral candidates] to work with colleagues and engineers, resulting in more interdisciplinary [knowledge]"*

Skretting: *"[Doctoral candidates] see real company issues and see how results are implemented. In addition to publication they also work on applied issues"*

Fasrund Aluminium Casting: *"It is easier to come to work in industrial field later. They get company experiences, in practice experiences and they get to know industrial solutions"*

Doctoral candidate B: *"I have also learned to handle both academic and industrial issues and people"*

Doctoral candidate P: *"Wider appreciation of other fields and how these can be incorporated into my own research"*

4.C. The collaborative scheme in practice

4.C.1. Setting-up the collaborative scheme

A common point highlighted by both universities and businesses throughout the workshops and the case studies is that building trustful relationships between the partners is essential to develop and to sustain the collaborative scheme. The definition of a common vision of realistic expectations, and a common understanding of each party's objectives and priorities, were aspects identified as a prerequisite to build trustful relations and to ensure a successful collaboration. The stakeholders clearly emphasized the importance of setting-up the collaborative project in advance. They stated that this stage should not be rushed, as it is a determining factor in the quality of the collaboration.

Across the workshops and case studies, the point that the industry contact person should be aware of what doctoral research entails, or should be a doctorate holder him/herself, was also highlighted. An adequate profile of the individuals involved in setting up and taking forward the collaborative scheme was, therefore, seen as an essential aspect to ensure the success of the partnership. The data from the case studies indicated that most universities and some of the companies surveyed had already on-going relations with the other partner before setting up the collaborative doctoral scheme. In some cases, collaboration was already occurring on a long-term basis and was well established. These relationships included different activities, such as the participation of industry staff in the university's activities (e.g., teaching, participating in governing boards, advisory roles), consultancy services provided by the university to the business, training provided by universities to

respond to industry needs (continuous professional development activities), or the existence of spin-off companies.

Regarding the set-up of the collaborative doctoral scheme, initial contacts and setting-up of the scheme between the university and the industry were, in most cases, established by individual initiative. In many cases, individual professors started paving the way to the collaborative schemes and the institutional support of the university followed through. In only about 24% of the case studies were institutional bodies (e.g., graduate school, different university offices) responsible for leading the scheme. The results of the case studies also indicated that, very often, the establishment of the collaborative scheme took about one year since the first contacts between the university and the industry partner.

As part of the process of setting-up the collaborative scheme, the stakeholders also emphasized the importance of establishing formal agreements between the parties. These contracts should be comprehensive in scope and rights and obligations of all parties should be clearly stated. The areas covered in the agreements typically include a combination of the following: general rules for the collaboration (description of the research project, duration of research, decision making procedures, rights and duties of each party), financial provisions and allocation of resources, confidentiality issues, IP ownership and rights over research outcomes with/without potential commercial use. The contract should also clearly state the commitments of the research beyond the project work for the company, i.e., course requirements, teaching, presentations, meetings, as well as to define what happens if the doctoral process extends beyond the agreed funding and who will pay for the extra time/money. In the majority of cases reported in the workshops and case studies, formal agreements between two (e.g., university-business; candidate-business) or the three parties were signed. In many cases, standard agreements were used, which could then be subject to negotiation depending on the specific research project concerned and the needs of the university and business partners. It was also considered beneficial to have a centre at the university that can provide standard contract models or expert advice.

Intellectual Property Rights (IPR) and confidentiality/disclosure arrangements were considered as one of the most important areas that should be covered in the collaborative scheme contracts. Universities and companies considered that IPR should be negotiated from the outset in the setting-up of the collaborative scheme, with a view to strike an appropriate balance of interests with respect to publication and potential commercial application. It was particularly emphasized that, in the context of a collaborative doctoral scheme, the right for the doctoral candidate to publish outcomes of his/her research should be ensured to guarantee the proper progress of the doctoral process. This should, preferably, be established before the start of the collaboration and the first research results. The case studies' results showed that when research results did not have commercial application, the most common case was the disclosure of the name of the business partner. On the other hand, when research results had the potential for commercial application, IP ownership tended to be retained either by the university and the business partner jointly, or by the university. The results of the case studies also indicated that in the fields of Science, Engineering and Technology (SET) and Biotechnology, Medical and Life Sciences (BML), IP rights tended to be retained either by both the firm and the university or by the university, while in Economics, Social Sciences and Humanities (ESSH) IP rights were, in most cases, only retained by the university. In the case of University College London (UCL), for example, the level of rights ownership depended on the level of funding by the

company – when the company did not fund the doctoral candidate all the IP rights belonged to the candidate.

On setting-up the collaborative scheme, another important factor is defining the type of contribution the company will make to the scheme. The most frequently reported type of contribution was funding. In the case studies conducted, the financial contribution of the business partner to the scheme was found to vary between 25% and 100% of the costs. Some universities also indicated that the share of private funding varied according to the size of the company, with SMEs typically contributing lower amounts than larger companies. In some of the collaborative schemes, co-funding procedures were included in the formal agreements between the university and the business. To cope with possible withdrawal of the firm from the scheme, and especially, to ensure that in such cases doctoral candidates had the adequate resources to complete their research project, universities and industries developed several safeguard mechanisms. For example, some companies reported having formal contracts with the university to ensure the viability of the research project, to have reserve funds for such situations or to choose cutting-edge doctoral research topics to ensure the continued interest of the firm in pursuing research in that particular area. In case of company withdrawal from the scheme, universities also provided funding to cover for the withdrawal. Some universities reported assessing the business partner financial situation before the outset of the scheme, to ensure the financial viability of the firm.

The importance of European and/or national-level funding for research was also highlighted by stakeholders. European and National funds were perceived as essential in building the research and development (R&D) capacity of a region or country. Public funding for collaborative doctoral programmes was also indicated as essential to develop a critical mass of researchers able to work both in and outside academia. The utility of public funding was also articulated with the special case of SMEs, who may be more reluctant to engage in a collaborative doctoral scheme. The doctoral scheme KESS was provided as an example of how to attract SMEs which are “not convinced” of the benefits of university-business partnerships. In this scheme, SMEs participation in the collaborative doctoral degree was associated to a low-cost, which helped them engaging in R&D processes. The consequent challenge was the sustainability of the engagement, that is, the development of an R&D culture within the company. To achieve sustainability of university relations amongst the “unconvinced” their expectations have to be managed properly. This also demonstrates the importance of public funds in broadening the R&D culture in the part of the private sector that is not basing its competitiveness in cutting-edge R&D.

Existing schemes of public funding for doctorates jointly supervised with companies, in which the research agenda is set by the company, such as the French CIFRE contract, the Norwegian model (with public intervention up to 50% of total costs with the rest of budget covered by the company) were also discussed throughout the workshops. Other models of funding covered in the project also included fully private funded doctoral theses. The latter was seen as a good way forward when the time between the research outcomes and their potential translation into commercial applications was short.

Other types of companies’ contributions to the collaborative doctoral scheme, other than funding, included supplying internal data for research purposes, supervising the progress of the doctoral

research project, providing placements in the firm or allowing the use of company facilities or equipment.

In setting-up the collaborative scheme, previous knowledge of the “Responsible Partnering” guidelines or other good practice initiatives between the university and the business sector was much more prevalent in the universities than in companies. Sixty-two per cent of the surveyed universities in the case studies reported being aware of good practice examples in university-business collaboration, while only one company reported the same. Interestingly, one university indicated that although there was awareness of such good practices at the top management level of the university, this did not permeate the other hierarchical levels at the institution, as individual faculty members or non-academic partners were not necessarily aware of these initiatives.

On a more concrete level, and regarding the choice of the doctoral research topic, according to the data gathered in the case studies, the selection of the topic was, very frequently, undertaken by considering the different needs and interests of the university, the business partner and the doctoral candidate. Less frequent was the choice of the research topic jointly by the university and the firm, or solely by the doctoral candidate. It was emphasized that, when the industry partner suggests a project, it is important to assess if this project contains enough scientific challenges for proper doctoral research content. There seems to be a need for protecting the doctoral candidate from being involved in too much applied research compromising the academic value of his/her research and thus his/her chances to earn the doctorate degree at the end of the research period. Several universities highlighted that involving the doctoral candidate in the choice of their research topic was extremely important for the successful completion of the project.

Regarding the formal requirements for admission to a collaborative doctoral degree, the data from the case studies indicated that the most common academic qualification when entering the collaborative scheme was a Master degree or a Master degree coupled with some professional experience. Additionally, other requirements for admission included interviews in the university and/or industry partner; previous experience in an industrial environment; knowledge of specific subject fields or scientific areas; need to undertake tests and consideration of the doctoral candidates’ skill profile, particularly the capacity to develop new skills. On entering the scheme, the most frequent legal status of doctoral candidates was being employed by the company, whether part- or full-time, being employed by the university or being a scholar funded by a public research funding body.

To attract doctoral candidates, universities reported using a variety of methods to disseminate information on the collaborative doctoral scheme. These included internal university promotion, dissemination in events held at the university or in conferences, dissemination in the media, on-line promotion (university web-site, external web-sites), and use of specialized information portals (EURAXESS). Companies, on the other hand, engaged more frequently in contacts with the university or used the network contacts of the company to disseminate the existence of the collaborative scheme. Evidence from doctoral candidates validated these sources of knowledge of the schemes. Most of them reported that initial knowledge about the scheme was gathered via the university or funding agency websites, in events held at the university or via their network of personal or professional contacts.

Selected quotes from participants:

NTNU: *"it is important that universities and companies planning a co-operation ensure that all important aspects of the co-operation are discussed before the project commences. This is often more complicated and time consuming than expected, and the importance of this process should not be underestimated"*

Ghent University: *"For each project (...) a contract is negotiated and specific arrangements (that comply with the needs and demands of the university and the company, and fit within the general framework of the funding agency) are made"*

Schlumberger: *"Trust relationship built with universities over the years".*

GSK Biologicals: *"If contract is well done – confidentiality how to proceed in case of patent. Excellent, define everything before"*

Umicore: *"Yes we avoid to withdraw. We have a bridge contract. We want to be serious. It happened once – panic time. We have reserve funding"*

4.C.2. Developing the research project

On developing the research project, stakeholders identified several broad aspects that should characterise the life-cycle of the collaboration in order to ensure its success. These included the importance of sharing resources between the different partners and building and maintaining trustful relationships. Regarding the latter, establishing a clear division of the each party's role, work and milestones was seen as an essential part of building trustful relationships. For example, in the workshops conducted, it was proposed that the academic supervisor should focus on new scientific knowledge, the company should focus on how to use the knowledge to further their business and the doctoral candidate should be the vehicle for the original research. The need to have committed and competent individuals in both partner organisations – university and industry – was emphasized, since ultimately they are the ones taking the collaboration forward. It was also considered that universities should check frequently with the industry partner to ensure the collaboration was satisfactory and that the company appreciated the depth of scientific knowledge brought by doctoral candidates/holders.

One of the main features of collaborative doctoral schemes is the supervisory arrangement. Indeed, what differentiates a collaborative doctoral programme from a traditional doctoral programme is the composition of the supervisory scheme: in collaborative schemes, an industrial supervisor must be a member of the supervisory committee in addition to the university supervisor. The results of the case studies conducted with universities, businesses and doctoral candidates confirmed this point. Indeed, in the vast majority of the reported cases, doctoral candidates had an advisor from the university and an advisor from the business partner. There were also several cases in which doctoral candidates had more than one academic supervisor (either from the same or from different departments/scientific areas) in addition to the industrial supervisor. The participants in the workshops and case studies emphasized that although in collaborative schemes the industrial supervisor is an integral part of the supervisory team, the academic supervisor remains the ultimate responsible for leading and ensuring the successful completion of the doctoral research project and

for the scientific soundness and quality of the research conducted. As the final responsible for the academic value of the project, the academic supervisor needs to ensure the project is of sufficient/appropriate academic quality to earn a doctorate degree.

Regarding the supervision process itself, the data from the case studies indicated that the frequency of meetings between the doctoral candidates and the university or industry supervisors was found to vary widely. In general, most meetings occurred on a need-basis and no fixed frequency was stipulated. Therefore, meetings could occur daily, monthly, every three months or just once a year. One important aspect is that doctoral candidates who were employed by the business partner typically met with the business supervisor much more frequently than doctoral candidates who were not based in the company. Meetings involving all stakeholders – doctoral candidate, university supervisor and industrial supervisor – were also held with varying frequency. The main point arising from both case studies and workshops was that regular contact among all the partners is extremely important to ensure an adequate progress of the collaborative doctoral project. Physical proximity and constant communication between the doctoral candidate, the company and the university was perceived by all stakeholders as essential to minimise misunderstanding or mistrust. It was also seen as of paramount importance in terms of balancing the structure and flexibility needed to develop a collaborative doctoral research project.

A related aspect is the existence of industry placements during the collaborative doctoral project. The results from the case studies showed that when doctoral candidates undertake placements in the business facilities, most of them do so as a member of the firm's research unit. In other cases, doctoral candidates may use the industry facilities as an individual worker on the thesis project. Placements in the firm may occur on a full- or part-time basis during the whole thesis project or take the form of temporary placements.

Monitoring the progress of the doctoral research project was perceived by stakeholders as very important, notably in the case of collaborative projects. Annual monitoring was considered appropriate and it should include: i) an outline of the doctoral project; ii) an annual monitoring (independent); iii) regular (e.g., monthly, quarterly) supervisory meetings with the university and the company key contact persons; iv) simulations of thesis examination. It was also highlighted in the workshops that a critical and regular review of the assessment tools may also prove highly beneficial. The stakeholders considered that although the experiences of doctorates based in the university or in a company are very different, it is essential for the supervisory relationships and processes to be adequate. The results from the case studies showed that monitoring of the research project's progress and the establishment of future research milestones was typically conducted once a year or, in some cases, twice a year.

A point arising in the workshops was that doctoral supervisors could benefit from specific "peer-to-peer" training for tutoring candidates involved in a collaborative doctoral process.

Selected quotes from participants:

Newcastle University: *"Monthly meetings are held between the student and the industrial and academic supervisors – these are typically via teleconference. On a three monthly basis, a face-to-*

face meeting is held involving the same parties as for the monthly meeting but with the project sponsor present to ensure the research is on track from a business and research perspective"

Doctoral candidate T: *"We have an annual review with CoMPLEX where two staff, external to my PhD, check my progress and provide support if I have any difficulties. Work plans and future tasks are logged and updated via the UCL Graduate School research log book roughly every 6 month."*

Doctoral candidate G: *"grand meeting with all the supervising parties every six months"*

Doctoral candidate U: *"We organize monthly a meeting to evaluate the progress of the research and new applications of our product"*

4.D. What makes for a successful collaborative scheme?

In establishing and taking forward a collaborative scheme, both universities and companies highlighted the importance of timely feedback and decision making processes, since this is often perceived as the main challenge to be overcome in the collaborative scheme process. The stakeholders mentioned that there is frequently a mismatch in the decision making timeframe of universities and businesses, due mainly to excessive bureaucracy or lengthy management procedures. This can delay the completion of important steps, particularly in establishing the partnership.

The stakeholders also emphasized that the collaboration between the company and the university should be seen as complementary, in which each partner brings its own expertise to the process in different tasks. In doing so, all stakeholders – university, company and doctoral candidate – need to understand and balance the needs, expectations and objectives of each other, and to find common ground to solve the challenges arising during the partnership. A related remark is the importance of identifying suitable individuals at the university and in the company to supervise a collaborative project, since this scheme requires a specific set of skills and competences from both parties. In addition, all those involved in the collaborative scheme should be committed in taking forward the partnership, as this is an essential condition for the scheme's success.

Finding a research project that simultaneously matches business needs and academic standards was also identified as a key element in collaborative doctoral education. Stakeholders indicated that a good academic idea is not always considered "good" for the market at that particular time and a proper balance of the academic and industrial relevance of the research topic should be sought. Another point related to the doctoral research topic is the development of research in the context of a team. While teamwork is a skill highly appreciated by companies, in doctoral education there is a limit to this concept: the research outcomes not only have to be original but also have to be originated by the doctoral candidate him/herself.

Stakeholders also highlighted that raising awareness of the importance of research for the business sector should be considered. This point was particularly emphasized in relation to SMEs, since larger companies are typically more aware of the value of research.

The topic of obtaining adequate long-term funding to establish and sustain the collaborative scheme was also identified as contributing to the success of the collaborative scheme. In addition, stakeholders also considered that, because doctoral collaborations may have the tendency to drift in time and scope, there is a need to put in place safeguard mechanisms. Examples of such mechanisms relate to clearly defining the course of actions to be taken and identifying the responsible partner for providing extra funds should the doctoral project extend beyond the established time or funding. Other topics that should be taken into account when planning and taking forward university-business partnerships referred to the need to find the right balance in the time doctoral candidates spend at university and in the business partner premises and to the need to reach agreements on IPR early-on in the collaboration process.

Overall, the outcomes of the workshops and case studies suggest that in order to successfully establish and take forward a collaborative scheme, it is essential to actively involve all relevant stakeholders in all the life-cycle stages of the scheme. Thoroughly planning the scheme and ensuring the continued contact and feedback between all the parties involved are also key aspects to consider when pursuing university-business partnerships.

Selected quotes from participants:

NTNU: *"When cooperating closely with industry, there is always a risk of applied research becoming more of consultancy work rather than research. Typical means to overcome these risks are: Scientific quality requirements of PhD projects"*

EPFL: *"different objectives, and different needs, which translate in different approaches and different timeframes. In these lies a risk of misunderstanding between the partners. There is therefore a need for an equilibrium that both partners need to find in the preparation of the collaboration: adapting the subject, identifying the key people, keeping the long-term view of the project"*

DIT: *"...challenges they were avoided from the start by including all partners in the design of the scheme from day one. The ethos of the scheme is that it breaks down boundaries between researchers, practitioners, professionals, policymakers, industry and the community by developing a dynamic research programme enabling collective identification of the research problems and solutions"*

GSK Biologicals: *"To companies: good collaborative academic lab and the company – you have to meet informally lots of times to build trust and not to leave the student alone"*

Doctoral candidate B: *"I believe it's one of the most frustrating task of a Ph.D. student located in industry and working with industrial tasks to combine and balance the interests and needs of industry and academia"*

Doctoral candidate I: *"Early feedback about this balance from both sides makes this challenge manageable and improves the usefulness and quality of the research results"*

4.E. Impact and sustainability of the doctoral scheme

The results from the workshops revealed that collaborative doctoral programmes are increasing in importance and many governments in Europe are developing their own schemes to foster this type of partnership. In addition, collaborative doctoral education is considered by practitioners as a good way to “test” university-business collaboration. However, many academics and companies are still reluctant in involving themselves in these partnerships. In this sense, during the workshops it was suggested that “peer-to-peer” activities from company-to-company and university-to-university could help the “non-convinced” ones to become more open and to encourage them to participate in the collaborative schemes. Collaborative doctoral programmes have a much higher impact than traditional programmes, as they respond directly to the partners’ needs and results have a direct application in the industry which results in increased prospects for knowledge acquisition and therefore more “value for money”.

During the workshops, it was highlighted that the impact of the research outcomes are as important in the more “hard sciences” disciplines (SET, BML) as in the ESSH field, although in the latter they are more difficult to quantify. This also applies to the areas of creative arts and media, where the often unpredictable research outcomes pose greater challenges in establishing partnerships. In the first workshop (Dublin), participants emphasized the importance of partnerships in the cultural and creative sector involving universities and philanthropic organisations. The added value of this collaboration in the framework of a doctoral programme goes beyond funding and includes consultancy services and networking linkages to the philanthropist.

Regarding the stakeholders opinions about the results of the collaborative scheme, the case studies revealed these were, overall, very positive. For doctoral candidates, this was mainly due to the opportunity to develop research in an industrial environment and the increased chances of employability in the industry sector. For companies, a collaborative doctoral scheme was seen as an opportunity to increase the competitiveness of the research developed in the firm and to explore different research areas, which consequently increased the competitiveness of the company itself. The collaborative scheme was also perceived as a valuable opportunity to test and recruit potential employees and to develop a network of contacts with the university. For universities, the opportunity to establish closer ties with the industry, more funding opportunities and the increased attractiveness of the institution were aspects also highlighted. The collaborative schemes were also perceived as having a positive impact at the regional/national level. The close ties between universities and the industry sector and the consequent development in the competitiveness of companies and the university contributed to attract more students and to provide companies with a wider, highly-skilled pool of candidates.

The results of the case studies indicated that formal systems to monitor and assess the impact of the collaborative schemes in universities and in the industry were at present limited or in the process of development. However, universities and companies reported holding informal activities to assess the impact of the scheme, such as joint seminars, conferences or more general events bringing together all stakeholders. Tracking the professional path of doctoral holders from the collaborative schemes was also used by some universities, although this was not a wide shared practice.

The results from the workshops and case studies indicated that in developing structured doctoral programmes, universities should consider how they are going to ensure the means to sustain the collaborative scheme throughout time. The large majority of participants in the case studies showed the intention of further pursuing the university-industry collaboration. Even though all schemes faced some type of limitation/constraint, the most frequent was funding because its continuation from either public or private sources was not ensured on a long-term basis. Collaborations are typically limited to time-specific programme budgets of international organisations or of companies, whose ownership and strategic concerns may change over time. To overcome this limitation, many universities were actively seeking to expand the funding sources of the collaborative schemes. This mainly entailed broadening the funding sources to include more participation from the private sector, research funding agencies or charities. Funding was also perceived by stakeholders as an important motivator to engage in university-business partnerships, since companies would be less likely to invest in speculative projects if they needed to fully cost them. In this context, public funding is extremely important in fostering university-business partnerships. However, this type of funding seems to be less likely to be granted in scientific areas where the impacts are hard to measure, i.e., where research results are not easily quantifiable.

Selected quotes from participants:

UCL BIOPROCESS: "Feedback from our Industrial Training Advisory Board (comprising 30 bioindustry professionals and which meets annually) suggests our EngD graduates have a major impact in industry. We have, via completed EngD collaborations, delivered new generic technologies which help achieve speed to market through novel UCL bioprocessing methods. Some companies have achieved up to a 50% reduction in development time. Other companies have used our methods to support new manufacturing licence applications for new therapies while emerging regenerative medicine companies are using EngD outputs to rapidly explore options for bringing entirely new types of human cell therapy to market".

Bangor University: "KESS has commissioned an external ongoing external evaluation. This will look at how all of the participants (academic and industrial partners and doctoral candidates) have benefitted and how the project has met its stated objectives. The evaluation will provide a mid-term report and annual progress reports before providing a comprehensive final report at the end of the project".

Skretting: "Relatively new for us. Indirect assessment. No monitoring system. We are happy right now"

Biotalentum: "We are new starters, we have no analyses yet, but because of the EU projects (Marie Curie programme) we are preparing the first report now. It is a 5 year long sponsored programme"

Solvay: "IP, co-financing/external recognition of risky projects/recruiting/ good consulting base, less expensive than the Big Consulting Firms, access to high end equipment, not worth an investment for industry ... employment"

Doctoral candidate R: "Most valuable are the contacts formed in industries that can be quite inaccessible to external researchers"

Doctoral candidate N: *"obtained results can find immediate application since they are equally driven by academia and business sector"*

4.F. Employment opportunities in the business sector

On a general level, collaborative doctoral programmes were considered to contribute to enhancing the personal and professional development of the population through research, building the R&D capacity of a region or country. On a more concrete level, pursuing and achieving a doctorate degree clearly enhances the employability perspectives of the individual, not only by broadening the spectrum of potential employment positions and sectors but also by enhancing the likelihood of reaching higher positions in their employment organisation in the long-term. This is clearer in larger companies than in SMEs, where the career perspectives in the long-term may be more limited. Companies involved in the workshops and case studies agreed that taking part in a collaborative doctoral scheme resulted in a boost of the firm's innovation, the opportunity to train doctoral candidates as future employees and the chance to gain access to new markets. Doctoral candidates working in companies are a source of new ideas and their work contributes to develop new areas of research in the company and to explore their potential applications. The company will hence become more professional as it increases its scientific knowledge.

The results from the case studies revealed that universities, industry and doctoral candidates all considered that doctorate holders graduated from a collaborative scheme were more employable in the business sector than doctorate holders graduated from a traditional programme. This was mainly due to the ability to bridge both sectors – university and industry, to being familiar with the industry culture and with the demands and constraints of the industry sector. The acquisition of the transferable skills was also deemed important to secure employment in the business sector. Interestingly, the perceived higher chance of securing employment in the business sector was also related to the doctoral candidates' motivations to enrol in a collaborative scheme. Many doctoral candidates reported that the possibility to obtain a better insight of the business sector, the increased employability chances in the industry sector and the opportunity to develop research more applied to specific and real problems were the main motivation to undertake a collaborative degree.

In spite of most doctoral candidates not having an obligation to work with the industry partner at the end of the scheme, many considered that the chances of being offered a position in the company were good. This was also corroborated by the views of universities and companies. For example, in the workshops, STATOIL indicated that, in order to minimise the risk of non-completion the doctoral thesis, employment opportunities involving in-house mobility between the technical and management company ladders was offered to doctoral candidates. The business sector also indicated that the capacity of a company to recruit a doctorate holder after the collaborative scheme depends mainly on the company's activity and capacity for long-term projects. In this respect, collaborations with SMEs still remain challenging. Results from the workshops showed that the most important obstacle is the absence in the SME of a person able to supervise a doctoral research project, except in the case of knowledge-based companies. Participants in the workshops suggested

that collaborations in joint supervision at Masters level was easier to achieve for SMEs as projects are shorter in duration. This would allow the necessary build-up of a long-term relationship based on mutual trust.

The majority of companies surveyed in the case studies indicated that they hired hiring doctorate holders mainly from the fields of engineering and technology and natural sciences. This was most likely due to the activity areas of the companies surveyed. Regarding the skill profiles that employers look for in a doctoral holder at the time of recruitment, technical expertise, problem solving and analytical skills (e.g. integrating ideas from a variety of different sources) were considered the most important attributes. Social skills were also considered important. Leadership potential and an entrepreneurial mind-set were considered as moderately important when recruiting doctoral holders. During the workshops, companies also indicated that there is a tension between the global and local recruitment of highly skilled professionals, such as doctorate holders. Some doctorate holders may be extremely strong in scientific skills, but may experience difficulties in fitting in firms abroad or in international organisations (e.g. language, societal/ethical or cultural differences).

According to the results of the case studies, when companies decide to hire doctoral holders they consider them, mostly, as a distinct group of highly trained graduates with a view to develop a long-term career in the company. Recruitment of doctorate holders on a case-by-case basis, who may then develop a long-term career in the company, was also frequent. However, companies also indicated that the particular characteristics of the vacancy and the need of a highly specialized workforce to cope with the long-term challenges that companies face is what usually underpins the recruitment of doctoral candidates.

Taking a closer look at the evolution of professional profiles of doctoral holders in the company, the case studies revealed that, at the time of recruitment, the largest proportion of doctoral candidates tended to be employed as researchers. However, after 5 to 10 years in the company, doctorate holders were evenly distributed across different professional profiles, such as research, project management or line management. The main difference in the professional profile of doctorate holders at the time of recruitment and after 5-10 years in the company was the drop in the number of doctorate holders in research positions and the increase in the position of line manager or similar.

Overall, companies were very satisfied with the quality of doctorate holders employed in the firm. The skills of doctorate holders were perceived as good or very good, specifically in relation to their scientific and technical expertise. However, occasionally the deep technical focus of doctorate holders was indicated as a weakness. For companies, the most important aspect seemed to be the balance between the deep technical focus and the breadth of knowledge of doctorate holders, coupled with an understanding of business processes and priorities. The principal areas of weaknesses of doctoral candidates pinpointed by companies were social skills, namely difficulties in teamwork, communication or organisational skills. Low levels of knowledge of the business environment and of business processes were also mentioned as a weakness in traditional doctorate holders. However, one company also highlighted that, in their experience, doctorate holders were more successful in developing their soft skills when entering the company than, for instance, Master graduates.

The companies surveyed in the case studies suggested that, in order to make doctorate holders more attractive to the business sector, academic training should focus more on creating an

entrepreneurial mind-set, on developing interdisciplinary knowledge and on fostering social skills, namely being a team player and having a customer-focused orientation.

Selected quotes from participants:

Newcastle University: *"The experience of undertaking research within an industrial environment and working within the constraints imposed by business equips the students to be much more aware of the drivers to take new ideas through a company. Additionally as the students are embedded within the company, they are working closely with industrial colleagues and hence it is more likely that they will be able to implement changes as a consequence of their research (...) Industry in some cases will only support EngD students as it is seen as an ideal training ground for potential employees. Additionally the students are exposed to the work environment and the challenges it presents";*

UNICAM Chemical: *"Based on my experience, most doctoral holders have received at the end of their doctoral programme the possibility of an employment contract in the same company".*

Ingolstadt University: *"For companies this scheme is very tempting as they are working with the candidate for several years, get to know him/her, get first-hand information and will eventually find their next co-worker (...) In addition, there is no long induction phase of the employee for the company which saves money again and makes immediate results more likely".*

Biotalentum: *"Yes, definitely, because of the experiences, training, secondments"*

Intel Ireland: *"Yes, definitely. They are more experienced, knowledge of industry world, built relationships"*

Alcatel Lucent: *"PhDs, they make a difference from Masters, they develop soft skills ok managers are coming out of research"*

Oryx Simulations AB: *"[We are] Pleased for the moment.[Doctoral candidates] would like to see long term challenging perspectives"*

Scandinavian Business Seating: *"Generic knowledge is missing with PhD holders – they have a very ideal mind-set, not realistic. They would need to have a general knowledge of the economy and real world. Hard to find a candidate that has both and not just the purely academic knowledge"*

OCAS: *"Weakness areas: accuracy, project management skills"*

Doctoral candidate P: *"I think non-academic sectors value those who have a head for business and can implement the research applicable to their company. Most PhD graduates have to be trained in a new area as their research has been too narrow and focused to be useful to the company entirely"*

Doctoral candidate S: *"I do feel more employable because of the training courses run during the EngD and the skills I have learned from this course as opposed to more traditional based programmes"*

Doctoral candidate B: *"For my plans of working in industry and for an industrial career later I believe I get a better training at the doctoral scheme compared to a standard one. Every day is training, going to the office, talking to colleagues, meeting customers or production personnel"*

Doctoral candidate S: *"Yes I do intend to work outside academia at some point in my future and see the EngD, with its high level of industrial collaboration, a useful step into a bio-industry career"*

4.G. Lessons learned and recommendations from stakeholders

Collaborative doctoral schemes are becoming more widespread and there is an increasing interest in this type of partnership. Although many practitioners see collaborative schemes as a good way to “test” university-business collaboration, several obstacles remain, namely some reluctance on the part of academics and companies to engage in this type of project. To overcome this challenge, participants in the workshops have suggested that “peer-to-peer” activities from company-to-company and university-to-university could help the “non-convinced” ones to become more interested and willing to take an active role in collaborative doctoral schemes.

During the workshops it was also emphasized that there is a need to create “communities of research” widely, fostering bridges between the academic and the business communities, and that universities and companies should be more open to the added-value of the collaboration. It was also considered that both universities and businesses should focus and capitalize on their own R&D strengths.

Thoroughly planning the collaborative scheme, involving members from the university and the industry partner, as well as defining formal agreements, especially for IPR, were deemed as extremely important to ensure the success of the collaborative doctoral scheme. In this process, striking a balance between academic and industrial priorities and needs is essential, but the long-term goal is to develop mutual trust between the partners and to strive for long-term relationships. By nurturing individual relationships over the years, partners come to a mutual understanding and find ways forward that do not compromise the core values and objectives of each other. During the workshops, all company representatives agreed on this point and highlighted that the process of clarifying goals may take several years of discussion. It was also indicated that although stakeholders may have different goals, finding common objectives is possible and desirable (e.g., common goals around employability needs).

Establishing and maintaining formal and informal contact between all the stakeholders involved in the collaborative scheme was also seen as essential to successfully take forward the scheme. In this line, ensuring the active involvement of the industry partner in the scheme, in terms of funding and supervisory responsibilities, and involving the company’s different hierarchical levels, including its top management representatives, was also deemed important.

The stakeholders underlined the need to be flexible in the types/modes of collaboration, adapting them to the different size and type of business involved in the partnership. In this regard, the engagement of SMEs in collaborative doctoral training was discussed. Although partnerships with SMEs bring about mutual benefits for all the partners, these firms still face some challenges in entering the collaborative schemes, namely due to the absence, in most cases, of a person within the company that can act as an industrial supervisor. A suggestion to help solve this issue arose in the workshops: collaborations involving joint supervision at Masters level is easier for SMEs, as projects are of shorter duration. The need for low financial investments of SMEs in the collaborative scheme was also indicated as a way forward to foster the participation of SMEs in the schemes. This would help support the development of R&D in the company and to build long-term mutual trust

among the partners. Public funding was also deemed important in broadening the R&D culture in the part of the private sector that is not basing its competitiveness in cutting-edge research.

Particularly in the case of collaborative doctoral schemes, ensuring the enrolment of doctoral candidates with the right profile is crucial. Throughout the DOC-CAREERS II project, it became apparent that the success of this type of doctoral programmes requires a person profile that is not only committed to research but that, at the same time, is willing to learn and make compatible two different ways of working. Particularly when based in companies, doctoral candidates may have to participate in technical negotiations and work with several levels of management. During the workshops, it was remarked that a proper promotion of the collaborative scheme and what it entails needs to be provided before and during the doctoral candidates' application process, making clear what are the rights, obligations, benefits and concerns of every party. It was also indicated that academic and industrial supervisors could benefit from specific "peer-to-peer" training for tutoring candidates involved in a collaborative doctoral scheme. Allowing doctoral candidates to participate in the choice of their doctoral research topic was also an aspect deemed important.

Stakeholders underlined the importance of the development of doctoral schools and how the consequent structuring effect is beneficial for all parties involved, as they provide guidelines and good practice examples. For instance, one workshop presentation showcased a doctoral school where courses are embedded in the industrial project and often require a problem-solving approach; thus, students learn how to discover and solve problems with limited time and resources, which has a positive effect on the doctoral research project itself. This school also focused on generic skills and provided courses in English, EU funding and IPR issues.

The need for more structured dialogue between different disciplinary areas (e.g. ESSH and SET/BML) as a way to foster mutual learning about practices in different fields was also emphasized. Discussions on collaborative doctoral programmes from different fields of knowledge could lead to a better understanding of the concepts of structure and flexibility in doctoral programmes. The example of the interdisciplinary collaborative doctoral programme CoMPLEX in University College London (UCL) was explored in the workshops. This scheme, involving joint supervision across UCL departments has allowed the development of in-house networks and the emergence of new research problems in a bottom-up perspective. The new fields of study emerging out of CoMPLEX's original approach attract companies, particularly because the exploratory nature of the results simplify the negotiations on IP issues, as companies don't find an immediate interest in exploiting the results at this stage of development.

Selected quotes from participants:

Dublin Institute of Technology: *"It is important that all partners including business are included in the design of the scheme from day one and not after the fact"*

Umeå University: *"Bottom up process with support from management, funding 50/50 gives engagement, supervision from company"*

UCL BIOPROCESS: *"We have found focussing doctoral research training around larger cohorts of students to be extremely beneficial. For the researchers involved this approach provides improved supervisory arrangements and greater opportunities for company involvement, more opportunities*

to be involved with a multidisciplinary cohort and to generate a wider network of contacts. For the centre/department these larger activities provide opportunities for enhanced provision of research training, a reduction in the unit cost of training provision and enhanced opportunities for income generation either from research funding bodies or industry".

Intel Ireland: *"I think that the conference we are organizing every year between the academic world and our technicians is a very good example that should be followed by other organizations"*

Fasrund Aluminium Casting: *"More connected to incentives – would be great to get tax reduce – would help a lot for smes"*

Skretting: *"Be very selective in selection process"*

Jansen Pharmaceutica: *"[Need for companies to have an] Entrepreneurial/exploratory spirit, bringing students into the business"*

Doctoral candidate B: *"For my plans of working in industry and for an industrial career later I believe I get a better training at the doctoral scheme compared to a standard one. Every day is training, going to the office, talking to colleagues, meeting customers or production personnel"*

4.H. Main messages

The main outcomes of the DOC-CAREERS II workshops and case studies can be summarised into the following brief main messages:

Validation of DOC-CAREERS outcomes: The input provided by the contributing persons and organisations fully validated the finding and conclusions of the FP6 DOC-CAREERS report. Thus, the new collected evidence reinforces the main messages and increases the evidence of successful collaborative doctoral programmes, both bottom-up and top-down. The seven components of the collaborative doctoral programmes identified in the FP6 DOC-CAREERS project remain essential and, in particular, the involvement of a supervisor from the industry sector, remains as the distinctive characteristic of these types of collaboration.

Regional Workshops: A useful tool to foster university-industry research collaborations: DOC-CAREERS II project developed a methodology to organise Workshops that bring together all stakeholders for fruitful discussions. With the "double-acts" and "triple-acts" presentations the presence of main stakeholders is ensured and this allows deeper dialogue, which is both focused and holistic.

Trustful relations: Building and maintaining trustful relationships among all stakeholders is essential to ensure the success of the collaborative doctoral scheme. Understanding each partner's needs and objectives, establishing clear and realistic expectations and ensuring regular contact between the parties is vital to build trust and to develop long-term university-business partnerships.

Planning the collaborative scheme: Planning the activities of the doctoral theses and ensuring that they all make sense within the framework of the theses well in advance is a determining factor in the

quality and functioning of the partnership. Involving all stakeholders in the different life-cycle stages of the scheme is also needed to ensure the success of the scheme.

Agreements and formal arrangements: Comprehensive agreements between all the stakeholders should be established before the start of the collaborative scheme. These should include the rights and obligations of each party, general rules for the collaboration, financial provisions and intellectual property ownership and rights. IPR should be negotiated from the outset, with a view to strike an appropriate balance of interests in relation to publication and potential commercial application of the research results.

Supervision: Although the academic supervisor is ultimately responsible for ensuring the doctoral research project is of appropriate academic quality to earn a doctorate degree, the industrial supervisor is an integral part of the collaborative scheme. Participants in the workshops and case studies agreed that the company supervisor should have a doctorate degree him/herself or, alternatively, should be aware of what doctoral research entails. Academic and industrial supervisors could also benefit from “peer-to-peer” training for tutoring doctoral candidates involved in collaborative schemes.

The “right people” profile: Taking part in a collaborative doctoral scheme requires a specific skill set. Doctoral candidates should not only be committed to research, but should also be willing to develop their work in an industrial setting, making compatible two worlds – academia and industry. Academic and industrial supervisors should understand each other needs and priorities and be committed to take the partnership forward ensuring the quality and progress towards the achievement of the doctoral degree.

Diversity of collaborative models: There is no “one-size fits all” model for collaborative doctoral training. Instead, the workshops and case studies have shown a variety of successful models, emerging from both top-down and bottom-up levels. The key factor seems to be the involvement of all hierarchical levels and, particularly, the support of top management levels, both in universities and in companies.

Employment: All stakeholders agreed that doctorate holders from collaborative schemes are more employable in the business sector than doctorate holders from traditional programmes. The ability to be “bilingual”, bridging the academic and industry sectors, and the development of transferable skills, were identified as the main reasons accounting for the enhanced employability perspectives of doctorate holders in the business sector.

Interdisciplinary dialogue: Participants in the workshops identified the need for more dialogue between the SET, BML and ESSH fields. Closer linkages between the different scientific fields are beneficial to foster mutual learning and to share good practice examples.

The specificity of SMEs: SMEs still face some challenges in engaging in collaborative doctoral programmes (e.g. absence of someone to act as industrial supervisor, funding difficulties). To overcome some of these challenges, participants in the workshops have suggested that SMEs could engage in joint supervision in Master level degrees, as these projects are shorter in time. The need to develop collaborative schemes that require a low level of investment from SMEs was also

suggested. In this vein, public funding, national or European, for collaborative doctoral schemes is essential to develop the R&D culture in SMEs.

Overcoming barriers to collaborative doctoral education: To overcome some reluctance on the part of academics and companies to engage in a collaborative doctoral schemes, “peer-to-peer” activities from company-to-company and from university-to-university could be used to change stereotypes and to develop more positive expectations of university-industry collaboration, with a view to bring more partners into university-business collaborations.

Public support: Public support is always mentioned as an essential component of collaborative research. It includes, obviously, funding, but also proper legislation to encouraging, or at least not hindering, it. Rewards for university scientists involved in collaborative processes are one of the measures. Legal frameworks that support both universities and businesses in preserving their interest while fostering collaboration are also crucial.

The regional dimension: All case studies in DOC-CAREERS II had a strong local base. While all consistently met the characteristics of the seven main components of collaborative doctoral research (identified in DOC-CAREERS) in all regions in which the programmes operated, the collaborative doctoral agreements were possible only because of a deep understanding of the regional industry dynamics and local/regional/national legal issues.

The policy dimension: It was clear that the regions fostering their competitiveness through innovation from university R&D do value collaborative doctoral programmes and the skills that doctoral candidates acquire through the process. These regions establish policies that support research collaborations and commit resources through local/regional public programmes and encourage the participation of local SMEs. These regions encourage also applications for funding from European and worldwide competitive calls and push for mobilising private funding.

Potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and exploitation of results

DOC-CAREERS II contributed to build evidence towards the continued development of an EU integrated policy strategy for researchers in Europe through focusing upon the varied and changing research environments in which doctoral programmes are situated, how they are adapting to these realities and the consequent implications for future career development. It made an important contribution, therefore, towards the plans for the continued development and implementation of the Green Paper on “The European Research Area: New Perspectives”, the recent 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”.

The Regional Workshops aimed at identifying tools and incentives that may have wider application across Europe to promote collaborative doctoral education. Very importantly, the organisers of the five regional workshops indicated the following added values that the DOC-CAREERS II workshops brought to their institutions:

- Promoted collaborative doctoral education partnerships
- Improved regional, interregional and national cooperation
- Enhanced European networking
- Increased regional community awareness of university activities
- Highlighted main approaches and solutions to problems in university-business cooperation
- Shared knowledge between actors from different sectors
- Assisted in developing network
- Assisted in building consortia for application for funding
- Promoted collaborative doctorate and doctoral degree
- Provided good platforms for participation of SMEs

The main conclusion of the project was that regional workshops were excellent tools for fostering university-business collaboration in the framework of doctoral education.

DOC-CAREERS II sought to have strategic impact upon the work of a wide range of practitioners involved in higher education and research, industry and other stakeholders and policy makers across Europe. DOC-CAREERS II aimed particularly for impact at the institutional level, universities, employers and key bodies concerned with knowledge production and dissemination. The various impact areas can be summarised as follows:

1. European Universities: contributed to achieve greater awareness of skill developments in doctoral training in Europe with a view of career development and employability; possibilities for optimising their own doctoral programmes; examples of good practice on the basis of which to proceed to the adaptation of their own programmes and structures; improvement in regional cooperation and networking in a dialogue with different potential employers.
2. Academics involved in European higher education and research programmes: greater awareness of skill developments and mobility strategies in doctoral training in Europe with a view of career development and employability in doctoral programmes in Europe; good practice examples of restructuring curricula to reflect demands of various sectors.
3. Public research bodies offering doctoral programmes or working with universities: greater awareness of skill developments and mobility strategies in doctoral training in Europe with a view of career development and employability in doctoral programmes in Europe; development of European cooperation and networking; widening the dialogue with potential employers.
4. Actual and potential doctoral candidates in Europe: awareness of changing needs of the labour market that require wider skills and experience; greater ability to choose courses according to the needs and demands of different sectors and multiple careers.
5. Employers of doctoral graduates, especially SME: greater awareness of developments within universities; improved dialogue with universities on needs and demands of the changing labour market; building partnerships, networks and joint initiatives aimed at improving collaboration between private and public sectors.
6. RTD performers, RTOs, etc: to strengthen the "research ecology" involving closer cooperation and networking between universities and other research performing organisations (both public and private) in building better frameworks for research careers and development
7. European policy-makers at national at European levels: raise awareness on key issues, e.g. pointing to and facilitating changes of legislation where needed; improvement of dialogue with all main stakeholders including social and industrial partners.

The use of project outcomes and the dissemination actions to date (events, communication and other dissemination tools) are described in the section below. EUA plans to continue to use and disseminate the outcomes of this project which has brought further evidence consolidating both the main mechanisms for establishing successful research cooperation and main policy messages. In addition, the outcomes of the project have wide potential further use and application both within EUA membership and with the external stakeholders. They will surely contribute to enhance the policy development regarding the university sector by providing strong messages based on the evidence and on the strategic developments in Europe.

EUA will further disseminate the outcomes of the project in its related events and conferences, including those organised by EUA-CDE. Dissemination plans for the future include a number of activities which are a continuation of these presented below (for example, Dr. John Smith will participate at the ASTP/ProTon Conference in Warsaw 18-20 October 2013; Dr. Lidia Borrell-Damian

will speak at the "Invest in Researchers - Better training and careers using new funding opportunities" to be held in Vilnius, 14–15 November 2013).

The outcomes of this project naturally link to the recent efforts and developments that EUA is putting in relation to the Memorandum of Understanding signed between EUA and the Commission 17 July 2012. They also link with the analysis that EUA is carrying out together with the JRC-IPTS on Smart Specialisation Strategies, where the place that collaborative research in general, and collaborative doctoral education in particular, must be clearly defined and included in regional plans for developing innovation based on R&D. In this sense, EUA can contribute to foster the role of universities in defining regional innovation agendas and issue guidelines at European level to assist universities. EUA will also use the project outcomes to feed into the upcoming review of the Responsible Partnering Guidelines, in collaboration with EIRMA and EARTO.

The outcomes of DOC-CAREERS II will be analysed jointly with the outcomes of the EUIMA project to contribute to build evidence that will help the development of measurement tools to assess the quality of the building up and progress of collaborative research cooperation processes. In addition, the outcomes of this project will be fully integrated in the development of the future support action in the field of energy, the FP7 UNI-SET project, which is an action that will aim at organising the voice of the university sector to create clusters of universities and to contribute to policy development in this field, particularly in supporting the implementation of the SET Plan. The university-business research collaboration will be an integral part of the development of the action.

Use of project outcomes and the dissemination actions: events, communication and dissemination tools to date (September 2013)

The two sections that follow describe and list in detail the activities which have been undertaken by EUA for the use of project outcomes (section 1) and the dissemination actions: events, communication and dissemination tools

1. Use of project outcomes

The outcomes of the DOC-CAREERS II project have been widely used in EUA activities related to research and innovation and particularly in researchers training, employment opportunities and researchers' careers. These can be classified as follows:

- 1.A. Policy Consultations with the European Commission and the European Parliament
- 1.B. Input into EUA and EUA-CDE Policy Declarations and Positions
- 1.C. Participation in dedicated EU R&I Stakeholders Fore policy dialogue
- 1.D. Linkages with EUA-CDE activities
- 1.E. Linkages with other EUA projects

1.A. Policy Consultations with the European Commission and the European Parliament

1.A.i. Participation in European Commission consultation meetings and expert groups

Presence of EUA in Expert Groups and Ad-hoc Meetings organised by the European Commission in relation to doctoral programmes, researcher's careers, Modernisation Agenda, EIT, ERC, Horizon 2020, etc., including:

- Expert Subgroup on "Human Resources and Mobility Steering Group" (Brussels, 11/01/2011);
- EUA participated in the consultation process leading to the "Principles for Innovative Doctoral Training" (Brussels, 27/06/2011) – part of the Report of Mapping Exercise on Doctoral Training in Europe "Towards a Common Approach", adopted by the ERA Steering Group on Human Resources and Mobility"
- Expert Subgroup on "Skills" (Brussels, 02/02/2012)
- Brainstorming on the Modernisation Agenda at DG EAC (Brussels, 25/01/2012);
- Consultation on Common Strategic Framework (Stakeholder meeting; Brussels, 01/03/2011);
- Meetings on Marie Curie actions:
 - Development of a "European Industrial PhD" programme (EC People Advisory Group; Brussels, 08/02/2010);
 - Marie Curie Industry Stakeholders Meeting (Brussels, 07/07/2010);
 - Marie Curie Consultation Meeting on Business-Academia PhD (Brussels, 10/11/2010);
 - Expert Subgroup on "Research and Innovation Staff Exchange" (Marie Curie Actions Stakeholder meeting; Brussels, 08/05/2012);
 - Expert Subgroup on "Individual Fellowship" (Marie Curie Actions Stakeholder meeting; Brussels, 14/05/2012);
 - Horizon 2020 – Marie Curie Actions Stakeholders meeting (COFUND; Brussels, 15/06/2012);
- ERA Framework – Meeting with Stakeholders (Brussels, 21/06/2011);
- Common Strategic Framework (CSF) for Research and Innovation – Energy (Stakeholders' workshop; Brussels, 23/06/2011).

1.A.ii. Strategic dialogue with European Institutions and Initiatives

- Meeting with MEP Morten Løkkegaard (Brussels, 09/02/2011);
- Meeting with Robert-Jan Smits of DG Research and Innovation (Brussels, 25/02/2011);
- Workshop "Enhancing and focussing EU international cooperation in research and innovation: A strategic approach" (Brussels, 13/03/2012);
- EPP Group hearing on Horizon 2020 (Brussels, 06/06/2012).

1.B. Input into EUA and EUA-CDE Policy Declarations and Positions

Reference to the outcomes of the DOC-CAREERS projects is always included in all relevant EUA and EUA-CDE policy statements:

- Salzburg II Recommendations: European Universities' Achievements since 2005 in Implementing the Salzburg Principles, 21st October 2010 (attached – Policy declarations and positions 1.pdf);
- Smart People for Smart Growth: Statement by the European University Association on the EU Flagship Initiative “Innovation Union” of the Europe 2020 European Strategy for Smart, Sustainable and Inclusive Growth”, 3rd February 2011 (attached – Policy declarations and positions 2.pdf)
- European University Association (EUA): EUA position on the EC “Green Paper” on a Common Strategic Framework for EU Research and Innovation Funding; 10th May 2011 (attached – Policy declarations and positions 3.pdf);
- EUA position on the EC consultation document on the “ERA Framework”, 30th November 2011 (attached – Policy declarations and positions 4.pdf);
- Memorandum of Understanding between the European Commission and the European University Association, 17th July 2012 (attached – Policy declarations and positions 5.pdf)

1.C. Participation in dedicated EU R&I Stakeholders Fora policy dialogue

Participation in dedicated European policy development dialogue included meetings and events organised by the Responsible Partnering Initiative partners (EUA, EARTO, EIRMA, ProTon) and with other bodies such as the European Institute of Innovation and Technology and the European Science Foundation.

- The Responsible Partnering Guidelines published in 2005 were thoroughly revised and re-published in 2009. The revised guidelines used the outcomes of DOC-CAREERS project throughout the text, contributing to the promotion of establishing projects and agreeing on solutions to concerns for the benefit of all partners on an equal basis and not with the assumption that one party is at the service of the others. A very concrete example of the contribution is the “Suggested Checklist for Situations Involving Collaborative Research Training” (p. 28 of the Responsible Partnering Guidelines), which are the final “Twelve messages for developing collaborative doctoral programmes” that encapsulated the essence of the DOC-CAREERS project findings (p.110 of the DOC-CAREERS report)
- EIT Conference “The role of the EIT in the Education Landscape” (Leuven, 02-03/12/2010)
- Responsible Partnering Initiative – Core Group Meeting with EARTO and EIRMA (Brussels, 11/07/2011, 29/09/2011)
- Participant at the First Workshop Member Organisation Forum on Researchers Career Development (Brussels, 09-10/02/2011);
- Horizon 2020 – Science Business Policy Bridge (Brussels, 27/03/2012)

- Member of the Advisory Panel to the FP7 Project called “European Laboratory for Modelling the Technical Research University of Tomorrow” (Ulab) – 2011-2012 (the 2nd Advisory Panel Meeting was hosted by EUA in Brussels, 01/06/2012).

The work of DOC-CAREERS and DOC-CAREERS II is reflected also in other projects and initiatives developed by EUA and EUA-CDE:

1.D.Linkages with EUA-CDE activities

- Report to EUA membership: presentation of DOC-CAREERS outcomes in the seminar on Doctoral Education organised back to back with the EUA Council under the Spanish Presidency (Sevilla, 25/03/2010; attached – Linkages EUA-CDE activities 1.pdf)
- Continuous mutual update of and input to activities between in EUA Research and Innovation unit and EUA-CDE, normally between Dr. Lidia Borrell-Damian and Dr. Thomas Jorgensen.
- Participation of EUA Research and Innovation staff (Dr. John H. Smith, Dr. Lidia Borrell-Damian) in EUA-CDE Steering Committee meetings when relevant;
- Participation of EUA Research and Innovation staff (Dr. John H. Smith, Dr. Lidia Borrell-Damian) in EUA-CDE workshops when relevant.

1.E. Linkages with other EUA projects

- FP7 project “European Universities Implementing their Modernisation Agenda” (EUIMA): this project looked at how universities work with regional partners in establishing long-term collaborative research initiatives and exploring how institutions develop research assessment tools in relation to their strategic missions and their context. In this respect, collaborative doctoral education is a particular case of collaborative research, very well delimited in time and objectives. The outcomes of the DOC-CAREERS II project have been presented or provided input in the EUIMA workshops indicated below. The programme and presentations of the workshops are available on the EUIMA website (www.eua.be/eua-projects/current-projects/euima/euima-collaborative-research.aspx):
 - Workshop 1 – Leuphana University, Germany, (5-6/10/2010)
 - Workshop 2 – Tampere University of Technology, Finland (22-23/02/2011)
 - Workshop 3 – Karlstad University, Sweden (12-13/05/2011)
 - Workshop 4 – Politecnico di Torino, Torino, Italy (07-08/11/ 2011)
 - Workshop 5 – University of Cambridge, United Kingdom (5-6/12/2012)
 - EUIMA project final event – Brussels (20/05/2012)
- EUA Project funded by the Life Long Learning Programme called “Mapping University Mobility of Staff and Students” (MAUNIMO) - Final Conference, Oslo (04-05/09/2012; attached – Linkages EUA projects 1.pdf)
- ARDE project on “Accountable Research Environments for Doctoral Education” (www.eua.be/eua-projects/accountable-research-environments-for-doctoral-edu.aspx). This was a project coordinated by EUA, particularly EUA-CDE. It involved

many EUA members who also contributed to DOC-CAREERS II project. The ARDE project report entitled “Quality Assurance in Doctoral Education – results of the ARDE Project” (2013) included numerous references to DOC-CAREERS II and a section dedicated to career development (p. 36-41). This report can be found on the ARDE project website:

www.eua.be/Libraries/Publications_homepage_list/EUA_ARDE_Publication.sflb.ashx

2. Dissemination: events, communication and dissemination tools

Benefiting from the extensive experience of the EUA in disseminating project outcomes and communicating with its large membership base has allowed the project to reach to the wider higher education and research communities across Europe, including more than 800 EUA member universities, 34 rectors' conferences and numerous university and research organisations and networks. To do this, various communication channels were used throughout the project, including dedicated websites for the project and its events, newsletter articles, targeted mailings to various contacts as well as other tools which have facilitated engaging relevant stakeholders. All these have been instrumental on the one hand in promoting the projects' activities as well as for disseminating the outcomes and findings resulting from the project's events. Specifically, these include:

- 2.A. Dissemination events: Presentations/Chair of sessions in conferences and events
- 2.B. DOC-CAREERS II website
- 2.C. EUA Newsletter
- 2.D. Interviews and input to external projects
- 2.E. Publication of outcomes in peer-reviewed journals and in scientific monographs
- 2.F. Input to specialised media
- 2.G. Other dissemination tools

2.A. Dissemination events: Presentations/Chair of sessions in conferences and events

EUA is regularly invited to present outcomes of the project to raise awareness of collaborative doctoral education issues and discuss on implications for policy development.

EUA is permanently promoting the outcomes of DOC-CAREERS and progress of DOC-CAREERS II in relevant activities in the field of research, doctoral education and university-industry collaboration, including links with EUA-CDE and the Responsible Partnering initiative. This is normally done in the form of dedicated presentations adapted to each audience. During the project, the following dissemination events took place:

- “Breakfast Briefing: Launch of the DOC-CAREERS Report”, Swiss Mission (Brussels, 09/12/2010; attached – Dissemination events 1.pdf)
- Third European University / Business Forum on “University-Business Cooperation for smart, sustainable and inclusive growth”: Dr. Lidia Borrell-Damian gave a presentation in collaboration with EIRMA President, Dr. Leopold Demiddeleer under the framework of the Responsible Partnering Initiative. She was also Moderator of the Session (Brussels, 4-5/05/2010; ; attached – Dissemination events 2.pdf)

- Presidency Conference on “Universities 2020” under the Spanish Presidency (Salamanca, 17-18/06/2010; attached – Dissemination events 3.pdf)
- EAIE Conference, Session No.10:06 on “DOC-CAREERS: linking doctoral education and industry” (17/09/2010) – Session organised and chaired by EUA with speakers from institutions that had contributed to DOC-CAREERS (Université Pierre et Marie Curie, France; University of Newcastle, UK), following the approval of a bid presented by EUA to the scientific committee of the conference. Dr. Lidia Borrell-Damian had a double role of Speaker and Chair (Nantes, 17/09/2010; attached – Dissemination events 4.pdf)
- EUA-CDE Workshop on doctoral Education: Dr. Lidia Borrell-Damian chaired a session on University-Business cooperation in Doctoral Education during the EUA-CDE Budapest workshop (Budapest, 20-21/01/2011; attached – Dissemination events 5.pdf)
- University-Business Forum (Brussels, 23/03/2011; attached – Dissemination events 6.pdf)
- EURODOC conference, presentation entitled “Collaborative doctoral education – a way towards enhanced employability and career perspectives” (Vilnius, 01-02/04/2011; attached – Dissemination events 7.pdf)
- Conference on “Youth on the Move”, Journalists Seminar, session on “Challenge and change: Developing modern education and training systems in Europe” (Florence, 07-08/05/2011; attached – Dissemination events 8.pdf)
- Conference on “Training, Career and Mobility of Researchers” (Hungarian Presidency of the Council of the European Union; Budapest, 28-29/06/2011; attached – Dissemination events 9.pdf)
- FP6 Marie Curie Conference “Increasing researchers’ employability in Europe: Marie Curie Actions’ Formula for successful careers”, presentation entitled “Collaborative doctoral education – a way towards enhanced employability and career perspectives” (Paris, 03-04/10/11; attached – Dissemination events 10.pdf)
- CRUE Sectorial I+D Conference “XIX Jornadas de Investigación de las Universidades Españolas”, presentation entitled “University-business relations, regional innovation and doctoral education in collaboration with businesses and other external partners” (Málaga, 27-28/10/11; attached – Dissemination events 11.pdf)
- DOCENT conference, presentation entitled “Collaborative Doctoral Education: University-Industry Partnerships for Enhancing Knowledge Exchange DOC-CAREERS project” (Bologna, 13/10/2011; attached – Dissemination events 12.pdf)
- Umeå Seminar on Doctoral Education “Meeting with Industrial Graduate School”, presentation entitled “Guidelines for collaborative research and knowledge transfer + The Salzburg Principles” (Umeå, 13-14/12/2011; attached – Dissemination events 13.pdf)
- European Business Summit “Skills for growth” (Brussels, 26/04/2012; attached – Dissemination events 14.pdf)
- OECD Roundtable: “Universities for skills, entrepreneurship, innovation & growth” (Paris, 20/09/2012; attached – Dissemination events 15.pdf)
- ProTon Europe, Annual Convention “From a tech transfer approach to a knowledge exchange approach”, presentation entitled “European universities in partnerships for knowledge

exchange and innovation: strategies and outcomes" (Liège, 21/09/2012; attached – Dissemination events 16.pdf)

- Delegation of Umeå University visiting EUA, presentation entitled "EUA in research, innovation and doctoral education" (Brussels, 29/10/2012; attached – Dissemination events 17.pdf);
- Cyprus Presidency Conference on ERA "Completing the European Research Area in the context of the Innovation Union – Boarding Time", presentation entitled "Mobility and Employment Fostering Innovation – Perspectives in University and Non-University sectors" (Nicosia, 14-15/11/2012; attached – Dissemination events 18.pdf);
- Danish Association of Research Managers (DARMA) visits Danish EU Research Office (DANRO), presentation entitled "The relationship between EUA and ERA – EUA in research, innovation and doctoral education" (Brussels, 28/11/2012; attached – Dissemination events 19.pdf);
- European Laboratory for Modelling the Technical Research University of Tomorrow (ULAB project) "Bridging R&D and Innovation: The role of European Universities", presentation entitled "European universities implementing the modernisation agenda – Main outcomes of the collaborative assessment part" (Brussels, 11/12/2012; attached – Dissemination events 20.pdf).

2.B. Website

As one of the main communication and dissemination tools, the project website (<http://www.eua.be/doc-careersii>) was set up at the beginning of the project offering a platform for publicising information about the project and its developments.

The project website includes a link to the first DOC-CAREERS Project and its corresponding report, as the pillars on which this Action was developed. DOC-CAREERS II project website has a general part describing main objectives and activities of the project and included a permanent Call for Expressions of Interest open to participation of interested universities until a late stage of the project implementation. The website also describes briefly the methodology, lists the calendar of events, and provides the list of members of the Steering Committee and clear contact details.

The project website also includes specific links to the presentations and outcomes of each workshop and thus makes available to the EUA community the various models of doctoral collaboration between universities and external partners at the regional/national level, and shows their experience, views and the incentive mechanisms that encouraged and fostered these collaborations.

2.C. EUA Newsletter

A key dissemination tool for EUA is the EUA newsletter, which reaches more than 10.000 subscribed persons and institutions, including EUA individual university members, collective members (national rectors' conferences, university networks), as well as a large range of staff in European universities, research organisations and other networks.

The DOC-CAREERS II team used the newsletter to disseminate the outcomes of all DOC-CAREERS II Workshops through short articles produced after each event. The stories provided a link to the web page where participants could find more details and use the presentations of the event, therefore achieving maximum outreach and impact. During the project, the following notes on DOC-CAREERS II activities have been published.

- DOC-CAREERS Launch Report – an EUA Breakfast Briefing (website announcement on 18/12/2009; attached – EUA Newsletter 1.pdf)
- DOC-CAREERS II 1st Call for Expressions of Interest (website announcement on 15/01/2010; attached – EUA Newsletter 2.pdf)
- DOC-CAREERS II 2nd Call for Expressions of Interest (website announcement on 14/10/2010; attached – EUA Newsletter 3.pdf)
- Note on DOC-CAREERS II First Workshop in Dublin (website announcement on 01/10/2010; attached – EUA Newsletter 4.pdf)
- Note on DOC-CAREERS II Second Workshop in Lausanne (website announcement on 16/12/2010; attached – EUA Newsletter 5.pdf)
- Note on DOC-CAREERS II Third Workshop in Kaunas (website announced 07/11/2011; attached – EUA Newsletter 6.pdf)
- Note on DOC-CAREERS II Fourth Workshop in Trondheim (website announced on 09/06/2011; attached – EUA Newsletter 7.pdf)
- Note on DOC-CAREERS II Fifth Workshop in Camerino (website announced on 20/10/2011; attached – EUA Newsletter 8.pdf)
- DOC-CAREERS II Final Conference (website announced on 22/09/2011; attached – EUA Newsletter 9.pdf)
- DOC-CAREERS II Final Conference highlights benefits of collaborative doctoral education (website announced on 02/02/2012; attached – EUA Newsletter 10.pdf)

2.D.Interviews and input to external projects

Dr. John H. Smith and Dr. Lidia Borrell-Damian also gave numerous interviews to specialist journalists, to general national media and to other organisation, disseminating the findings of the project and as an input to other external projects. These included:

- Interview with European Voice by Ian Mundell (29/04/2010; attached – Other communication 1.pdf)
- Interview with The Chronicle of Higher Education by Aisha Labi (06/09/2010; attached – Other communication 2,3.pdf)
- Interview with The Chronicle of Higher Education by Karin Fisher (02/09/2010; attached – Other communication 2,3.pdf)
- Interview with Oxford Research and Policy by Dr Sean McWhinnie (09/02/2010; attached – Other communication 4.pdf)

- Interview with Chemistry World Magazine (26/09/2011; attached – Other communication 5.pdf)
- Interview with Todd Davey for Hippo Project (29/10/2010; attached – Other communication 6.pdf)
- Contribution to the study performed by Deloitte aiming at supporting the ERA Impact Assessment (11/06/2012; attached – Other communication 7.pdf)
- Interview for the MCA interim evaluation with VitalisNakrosis (11/05/2012; attached – Other communication 8.pdf)
- Interview with Centre for Organisational and Human Resources Research of University of Ljubljana, Contribution to EMCOSU Project (30/05/2013; attached – Other communication 9.pdf)
- Interview about EURAXESS website with VilmaZotou (07/02/2013; attached – Other communication 10.pdf)

2.E. Publication of outcomes in peer-reviewed journals and in scientific monographs

The work developed throughout the DOC-CAREERS project has been an important input to DOC-CAREERS II. The outcomes of DOC-CAREERS have been published by EUA, in a scientific monograph entitled “Collaborative Doctoral Education: University-Industry Partnerships for Enhancing Knowledge Exchange” (attached – Scientific monograph.pdf).

Out of the success and excellent comments received by the community of experts in doctoral education in Europe, the Steering Committee of DOC-CAREERS project engaged in the drafting of an article with the aim to publish some of the main outcomes of the research in a peer reviewed journal. This objective was successfully achieved in December 2010 when the [Higher Education Policy](#), the Quarterly journal of the [International Association of Universities](#) (IAU), published the article entitled “Collaborative Doctoral Education: University-Industry Partnerships for Enhancing Knowledge Exchange” (attached – Peer reviewed article.pdf). The authors think that this was an excellent outcome of the project which validated the methodology and conclusions from an academic point of view. Indeed, since this publication EUA has been contacted by several academic directors in the UK and USA requesting a reprint of the article.

This publication was of high value for the DOC-CAREERS II undertaking, because it allowed the project team to consolidate the methodology used in the previous project and employ the same questionnaires (with some minor adjustments) to received input from the broader range of external partners that the second phase of the project intended to address (SME, NGO, other research organisations, civil organisations, health authorities, RTOs, etc.).

2.F. Input to specialised media

The results of DOC-CAREERS II have served as input to the following articles published in *Nature* journal:

- Outside the box (published on 23/02/2012; attached – Input to specialised media 1.pdf)
- PhDs leave the ivory tower (published on 05/04/2012; attached – Input to specialised media 2.pdf)
- PhDs fit for industry and commerce, too (published on 01/08/2012; attached – Input to specialised media 3.pdf)

The outcomes of the project have also been used as input to the following articles:

- Business groups rally round Horizon 2020 (Research Europe, 25/10/2012; attached – Input to specialised media 4.pdf)
- Universities agree PhD reform principles (University World News, 24/10/2010; attached – Input to specialised media 5.pdf)
- OECD maps PhD transferable skills progress (university World News, 21/08/2011; attached – Input to specialised media 6.pdf)
- Universities want to lead in Europe (Universiteitenwillenhoofdrol in Europa; Science Guide, 01/02/2011; attached – Input to specialised media 7.pdf)

2.G. Other dissemination tools

EUA's vast experience in running projects in higher education was crucial in developing tools to raise awareness about the aims of the DOC-CAREERS II project. To do this, a range of promotional material was created to increase the visibility of the project. As a good example, the DOC-CAREERS II project brochure were distributed not only at the DOC-CAREERS Workshops but also at all EUA's events and other events to maximise the outreach throughout Europe (attached - DOC-CAREERS II Leaflet). A stand-alone roll-up (attached - DOC-CAREERS II roll-up) was specifically designed to be used in DOC-CAREERS II events.

At every DOC-CAREERS II event and major EUA and EUA-CDE Conferences, copies of the two main documents for the project, the DOC-CAREERS report and the Responsible Partnering revised guidelines, were distributed to workshop participants.

Address of the project public website and contact details

1. DOC-CAREERS II project website: <http://www.eua.be/doc-careersii>

2. Contact details:

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