

Report of Mapping Exercise on Doctoral Training in Europe

"Towards a common approach"

27 June 2011

The goal of this report is to provide an overview of recent developments in doctoral training and identify a common approach. It contains ideas for supporting measures and suggestions for EU and Member States' strategies. Fiches presenting EU and national efforts to date can be found in annex

1. Policy context

Our economy needs to adequately absorb many new researchers. Cooperation between the academic sector and industry (in the widest meaning of the term), starting at the level of early research training, will strengthen the much needed research intensity of our economy. It is important to focus on doctoral training as this is the qualification that should enable researchers to move into a wide range of employment sectors. Across the EU, doctoral candidates are funded from a wide variety of national and international sources including various EC funding streams. There is now the opportunity to look ahead and shape the future of doctoral training in the context of the Innovation Union policy.

The Green Paper on the Common Strategic Framework¹ identifies the need to better integrate diverse funding schemes to advance the EU research effort in particular as regards the Framework Programme (Horizon 2020), including ERC and EIT and European Structural Funds (ESF). In order to support doctoral training more effectively, Europe needs a common understanding based on sound principles and international best practice. This report proposes such a common understanding for doctoral training and possible implementation mechanisms.

The issue of doctoral training has gained considerable importance in recent years. Doctoral training is a primary progenitor of new knowledge, which is crucial to the development of a prosperous and developed society. Developed economies rely on new knowledge and highly skilled knowledge workers to feed a process of continuous innovation. They rely also on adequately trained responsible citizens that can adapt to changing environment and can contribute to the common good. Grand societal challenges like climate changes and healthy ageing require complex solutions based on high level frontier research carried out by new generations of researchers. Several initiatives have been taken to identify and promote good practice in doctoral training, most notably, the EUA, through the Salzburg Principles and the Salzburg II Recommendations², which are at the basis of this mapping exercise.

The research profession as a whole needs to become more attractive and effective to provide Europe with a workforce qualified to cope with the grand challenges facing our societies. Although the number of researchers in the EU (1.5 million FTE in 2008) has been increasing since 2000 at a faster rate than in the US and Japan, the EU still lags behind in the share of

¹ 'From Challenges to Opportunities: Towards a Common Strategic Framework for EU research and innovation funding' (COM(2011)48).

² <http://www.eua.be/cde/about-euacde/euas-work-on-doctoral-education.aspx>

researchers in the total labour force. In 2008, this stood at 6 per 1000, compared to 9 in the US and 11 in Japan. The difference is due to a much lower share of researchers in the business sector: 46% of total researchers in the EU against 68% in Japan and 79% in US. Of note too is the rapid increase in the number of researchers in China which doubled from 0.7 in 2000 to 1.4 million in 2007. As regards R&D intensity, the EU - with 1.9% of GDP in 2008 - is also lagging behind the US (2.8%) and Japan (3.4%). There are about 600,000 doctoral candidates currently doing research in the EU and 110,000 graduating every year³.

If we want to increase the research intensity of our economies and reach the R&D target of 3% of GDP, the EU will need at least an estimated one million new research jobs⁴. This will require a better matching of supply (training of researchers) and demand (recruitment of researchers), a necessity acknowledged most recently in the Europe 2020 Flagship Initiative Innovation Union⁴, in the three interconnected commitments, nrs. 1, 4 and 30:

1. By the end of 2011, Member States should have strategies in place to train enough researchers to meet their national R&D targets and to promote attractive employment conditions in public research institutions. Gender and dual career considerations should be fully taken into account in these strategies.

In 2011, the ERA Steering Group on Human Resources and Mobility will discuss a roadmap and other means to establish such strategies. Effective doctoral training should be part of such strategies. An attractive research career starts with solid research training and continuously benefits from lifelong learning. Significant changes have occurred in doctoral training during the last decade. Further progress in this field will not only depend on enhancing doctoral training, but also on increasing the absorptive capacity of the economy. It is in particular important to convince the managers of small and medium sized enterprises the value of employing doctorate holders. Indicators on doctoral training will be included in the proposed Performance Scoreboard for Research and Innovation (see footnote 4).

4. In 2012, the Commission will propose [on the basis of the provisions on ERA in the New Lisbon Treaty] a European Research Area framework and supporting measures to remove obstacles to mobility and cross-border co operation, aiming for them to be in force by end 2014. They will notably seek to ensure through a common approach:

- quality of doctoral training, attractive employment conditions and gender balance in research careers;
- mobility of researchers across countries and sectors, including through open recruitment in public research institutions and comparable research career structures and by facilitating the creation of European supplementary pension funds;

The Commission will propose a common approach to help ensure that the next generation of doctorate holders can actively contribute to the Innovation Union. The common approach may include the recommendations that doctoral training should:

³ List of sources to be added.

⁴ Europe 2020 Flagship Initiative Innovation Union COM(2010) 546 final of 6.10.2010 http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf#view=fit&pagemode=none

- have a certain critical mass
- include transferable skills training
- respect the principles of the Charter & Code⁵,
- lead doctoral candidates to acquire the ability to challenge disciplinary borders
- encourage doctoral candidates to spend some research time abroad
- encourage doctoral candidates to spend some research time in industry or other relevant private / public employment sectors.

The common approach is meant to support the efforts of Member States to make the research profession more attractive. It may inform the design of national and European funding schemes.

30. By 2012, the European Union and its Member States should put into place integrated policies to ensure that leading academics, researchers and innovators reside and work in Europe and to attract a sufficient number of highly skilled third country nationals to stay in Europe.

Among other measures, the Commission will assess, in 2011, the implementation and impact of the "Scientific Visa" package. The Commission will expand its network of EURAXESS Links contact points across the globe to stimulate networking between European researchers worldwide. Non-EU doctorates per million population will be one of the indicators in the proposed Research and Innovation Scoreboard.

The work on doctoral training is coordinated through the ERA Steering Group on Human Resources and Mobility (ERA-SGHRM). Stakeholders from industry and academia are involved. This mapping exercise of current practice, including Marie Curie Actions, Erasmus Mundus, Structural funds and national initiatives, was finalised in spring 2011. Results will be cross-checked through a feasibility study in 2012, involving site visits to successful doctoral schools. There will be two new initiatives in 2012-2014, under the Marie Curie Initial Training Network Action, to fund European industrial doctorates and innovative doctoral programmes on top of research training networks. These initiatives could be a precursor of funding instruments under the Common Strategic Framework for Research and Innovation and set an example for other funding instruments at national and EU level (like the Structural Funds).

2. A common approach to enhance the quality of doctoral training

It is important to be clear at this point that the core component of doctoral training is the advancement of knowledge through original research. At the same time it is recognised that doctoral training must increasingly meet the needs of an employment market that is wider than academia⁶. The key role of universities as the accredited bodies for awarding doctorates is fully recognised. There are a number of key stakeholder initiatives that identify and promote good practice in doctoral training:

European University Association (EUA) - Council for Doctoral Education - Salzburg I and II Principles and Recommendations

⁵ http://ec.europa.eu/eracareers/pdf/am509774CEE_EN_E4.pdf

⁶ Salzburg Principles I

EUA has set up a membership activity dedicated to the development, advancement and improvement of doctoral education and research training in Europe. In the framework of the Bologna process, EUA launched in 2005, after extensive consultation through a structured bottom-up process, Conclusions and Recommendations on Doctoral Programmes for the European Knowledge Society, better known as "Salzburg Principles". These principles were confirmed and enriched, in 2010, in the Salzburg II Recommendations. The Salzburg Principles and Recommendations are widely endorsed and considered the most comprehensive set of guidelines on doctoral training that exist. They cover the nature of doctoral training, its structure and conditions for success⁷.

League of European Research Universities

LERU has produced a position paper describing its vision on doctoral training beyond 2010. Doctoral programmes should prepare researchers to the highest level to make important contributions to frontier research. In addition, they should prepare doctoral candidates to take up roles in driving complex changes in society. Doctoral candidates should be trained in a context which is international, interdisciplinary and intersectoral. Employers should be made aware of the unique set of skills that our doctoral researchers develop in the course of their training.⁸

Coimbra Group

The Coimbra Group has described the essential requirements for doctoral training and for the PhD degree defining standards for the independence of research, supervision, duration of study, quality assurance etc.. Special attention was given to templates for transferable skills and co-operation between doctoral schools and programs, including transatlantic cooperation⁹.

Thematic initiatives

Several thematic networks are in the process of defining standards for doctoral training in their field. In 2010, the Organisation of PhD Education in Biomedicine and Health Sciences in the European System (ORPHEUS) published a position paper "Towards Standards for PhD Education in Biomedicine and Health Sciences", laying down standards and identifying the characteristics of doctoral training for these disciplines¹⁰.

International initiatives

The US Council of Graduate Schools, the European University Association, the Canadian Association for Graduate Studies, the Deans and Directors of Graduate Studies (Australia), and the Association of Chinese Graduate Schools agreed in 2007 on the Banff Principles on Graduate Education¹¹. The nine principles include the development of global career competences and promote high quality inter institutional / international collaborative programmes.

⁷ <http://www.eua.be/cde/about-euacde/euas-work-on-doctoral-education.aspx>

⁸ http://www.leru.org/files/publications/LERU_Doctoral_degrees_beyond_2010.pdf

⁹ LEADER and TRANSDOC projects <http://www.coimbra-group.eu/index.php?page=dsr&hl=en>
"http://www.coimbra-group.eu/transdoc/"http://www.coimbra-group.eu/transdoc/

¹⁰ http://www.jfmed.uniba.sk/fileadmin/user_upload/editors/Andrisova_Files/Microsoft_Word_-_Setting_standards-PhD_study_Orpheus-12-05-2009-final_version.pdf

¹¹ http://www.cgsnet.org/portals/0/pdf/mtg_banffprinciples.pdf

United States

A joint commission set up by the US Council of Graduate Schools (CGS) and Educational testing Service (ETS) has produced an extensive report "The Path Forward, The Future of Graduate Education in the United States", outlining the challenges facing the hitherto very successful doctoral training in the US. The report points at demographics and the growing competition from Europe and Asia. The recommendations include the need to provide transferable skills training for US doctoral candidates. The advances made by EU countries in this regard are clearly recognised¹².

Member States initiatives

Several Member States have launched their own initiative to enhance the quality and effectiveness of doctoral training. An overview can be found in the annex.

Marie Curie Actions

Through the Marie Curie Actions the EU is promoting best practice in doctoral training as regards research excellence, attractive environment and employment conditions, interdisciplinary research, industry exposure, international networking and transferable skills training.

Best practice principles for innovative doctoral training

From these initiatives and others, we can distil the essential elements that are common to all. These could constitute a common approach to enhance the quality of doctoral training in Europe, namely:

Research Excellence

Striving for excellent research is fundamental to all doctoral education and from this all other elements flow. Academic standards set via peer review procedures and research environments representing a critical mass are required. The new academic generation should be trained to become creative, critical and autonomous intellectual risk takers, pushing the boundaries of frontier research.

Attractive Institutional Environment

Doctoral candidates should find good working conditions to empower them to become independent researchers taking responsibility at an early stage for the scope, direction and progress of their project. These should include career development opportunities, in line with the European Charter for Researchers and the Code of Conduct for the Recruitment of researchers¹³.

Interdisciplinary Research Options

Doctoral training must be embedded in an open research environment and culture to ensure that any appropriate opportunities for cross-fertilisation between disciplines can foster the necessary breadth and interdisciplinary approach.

Exposure to industry and other relevant employment sectors

¹² http://www.fgereport.org/rsc/pdf/CFGE_report.pdf

¹³ http://ec.europa.eu/eracareers/pdf/am509774CEE_EN_E4.pdf.

The term 'industry' is used in the widest sense, including all fields of future workplaces and public engagement, from industry to business, government, NGO's, charities and cultural institutions (e.g. musea). This can include placements during research training; shared funding; involvement of non-academics from relevant industry in informing/delivering teaching and supervision; promoting financial contribution of the relevant industry to doctoral programmes; fostering alumni networks that can support the candidate (for example mentoring schemes) and the programme, and a wide array of people/technology/knowledge transfer activities.¹⁴

International networking

Doctoral training should provide opportunities for international networking, i.e. through collaborative research, co-tutelle, dual and joint degrees. Mobility should be encouraged, be it through conferences, short research visits and secondments or longer stays abroad.

Transferable skills training

“Transferable skills are skills learned in one context (for example research) that are useful in another (for example future employment whether that is in research, business etc). They enable subject- and research-related skills to be applied and developed effectively. Transferable skills may be acquired through training or through work experience¹⁵”.

It is essential to ensure that enough researchers have the skills demanded by the knowledge based economy. Examples include communication, teamwork, entrepreneurship, project management, IPR, ethics, standardisation etc.

Business should also be more involved in curricula development and doctoral training so that skills better match industry needs, building on the work of the University Business Forum¹⁶ and the outcomes of the EUA DOC-CAREERS project¹⁷. There are good examples of interdisciplinary approaches in universities bringing together skills ranging from research to financial and business skills and from creativity and design to intercultural skills.

Quality Assurance

The accountability procedures must be established on the research base of doctoral education and for that reason, they should be developed separately from the quality assurance in the first and second cycle. The goal of quality assurance in doctoral education should be to enhance the quality of the research environment as well as promoting transparent and accountable procedures for topics such as admission, supervision, awarding the doctorate degree and career development. It is important to stress that this is not about the quality assurance of the PhD itself rather the process or life cycle , from recruitment to graduation.

The common approach should provide a framework of reference, whilst preserving flexibility and autonomy for institutions and doctoral candidates. A feasibility study in 2012 will examine the implementation of these principles at sample universities and will involve site visits to successful doctoral schools. The outcomes of these explorations could become part of the envisaged 2012 ERA framework proposal and/or supporting measures and could help to promote good practice in doctoral training across the continent.

¹⁴ <http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doc-careers/> (pages 43-44).

¹⁵ “Research Careers in Europe Landscape and Horizons”, European Science Foundation 2010

¹⁶ http://ec.europa.eu/education/higher-education/doc1261_en.htm

¹⁷ <http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doc-careers>

3. Models for organising doctoral training - the emergence of doctoral schools

Doctoral training can be organised in various ways depending on institutional profiles, national traditions, specific disciplines and availability of resources. The classical model of the master-apprentice relationship is gradually becoming less important and more and more universities are setting up doctoral schools that deliver structured programmes for cohorts of candidates. These programmes provide career development through coursework on disciplinary and transferable skills alongside their original research¹⁸.

Doctoral training can be organised at local, regional, national or international level. Many institutions opt for a mixed model, whereby the candidates complete generic courses locally and subject specific courses together with candidates from different institutions (or vice-versa). The majority of institutions have set up doctoral schools or programmes across several or all of their departments/disciplines.

Some countries have also set up national thematic doctoral training facilities or research schools (NOR, NL, IE), others have concluded agreements for international training networks (PT, Marie Curie Actions, Erasmus Mundus) or, like Spain, have developed regulatory frameworks¹⁹ to set up doctoral schools.

More and more universities engage in collaborative research with other institutions (joint programmes, which may lead to joint or double degrees), with research institutes or with industry and other relevant employment sectors fostering innovation. Genuine collaboration in doctoral training implies, among other aspects, a shared supervision of the work of the doctoral candidate²⁰.

Some institutions have set up graduate schools bringing master and doctoral programmes under one roof, but universities use their master programmes to identify and recruit good candidates and bring them in the research environment²¹.

The establishment of structured doctoral training (e.g. doctoral schools) is part of universities' move towards a more professional management of research strategies, including research infrastructure, recruitment and selection of candidates, human resources, training, quality assurance and assessment. Nearly half of all doctoral candidates are women²². The recruitment base has been internationalised. A more open competition for places can enhance quality. The median time to degree is lower and there are fewer dropouts. More and more institutions stay in contact with their doctoral candidates after graduation and trace their career.

¹⁸ http://www.ond.vlaanderen.be/hogeronderwijs/bologna/2010_conference/documents/EUA_Trends_2010.pdf

¹⁹ <http://www.boe.es/boe/dias/2011/02/10/pdfs/BOE-A-2011-2541.pdf>

²⁰ <http://www.eua.be/eua-work-and-policy-area/research-and-innovation/doctoral-education/doc-careers>

²¹ Some also engage in special actions to interest secondary school pupils for research.

²² She Figures 2009: In the EU-27, 45% of all PhD graduates were women in 2006; they equal or outnumber men in all broad fields of study, except for science, mathematics and computing (41%), and engineering, manufacturing and construction (25%). http://ec.europa.eu/research/science-society/document_library/pdf_06/she_figures_2009_en.pdf

4. Supporting measures - fostering excellence and building capacity

Various schemes exist at European and national level to support doctoral training. Support may be provided at the level of the individual candidate, the mentor, the school, the consortium or the funding programme. National programmes support the bulk of doctoral training in Europe. They are presented in the fiches in annex.

At European level, the most well known scheme specifically dedicated to the excellent and structured training of doctoral candidates are the Initial Training Networks (ITN) of the Marie Curie Actions (estimated total of more than 18.000 doctoral candidates supported during FP7). Other European funding sources include Erasmus Mundus (1400 doctoral candidates in seven years), and further programmes not mainly focused on doctoral training but effectively funding doctoral candidates and training, such as Erasmus (estimated 35000 one or two semester mobility grants under the current LLP programme), European Research Council (estimated 13000) the Cooperation Programme of FP7 (estimated 70,000²³), Structural Funds (estimated more than 50-100,000) and development aid programmes (estimated 1400).

EU programmes have a limited budget and cannot cater for all doctoral training needs in the European Research Area (in view of the envisaged one million new researchers' jobs). EU programmes can, however, set examples, promote standards and make a difference in areas or regions in need of special stimulus. Therefore, careful consideration should be given to the design of the new generation of EU programmes starting in 2014.

At present, the Commission has launched new initiatives in 2012, under the Marie Curie Actions, in order to test innovative doctoral programmes and European industrial doctorates, that could set examples for future EU and national funding schemes. Participating universities, as well as research organisations and companies, would practice most of the characteristics outlined above and share their experience with others.

Special attention may be needed in the future to the issue of capacity building in less developed regions, including through the use of Structural Funds. Societal challenges will require the training of doctoral candidates in targeted research areas. Smart specialisation, playing on strengths and targeted investment may be combined with networking and twinning arrangements.

5. Informing EU and Member States' strategies

The Innovation Union Communication sets out that, by the end of 2011, Member States should have strategies in place to train enough researchers to meet their national R&D targets and to promote attractive employment conditions in public research institutions. Gender and dual career considerations should be fully taken into account in these strategies. Indicators related to doctoral training will be included in the proposed Performance Scoreboard for Research and Innovation and special attention will be given to gender issues:

- New doctorate graduates (ISCED 6) per 1000 population aged 25-34

²³ Estimated one per project participation

- Percentage population aged 30-34 having completed tertiary education
- Percentage youth aged 20-24 having attained at least upper secondary level education
- Non-EU doctorate students per million population²⁴

In spring 2011, the ERA Steering Group on Human Resources and Mobility will discuss a roadmap and other means to establish such strategies. The current report and its annexes will be part of the input for this exercise.

²⁴ Non-domestic doctoral students for non-European countries.

ANNEXES

Annex 1: Models for Doctoral Training

- A) University-wide doctoral training
- B) National inter-institutional cooperation
- C) Thematically organised doctoral training
- D) International cooperation
- E) Doctoral training in cooperation with industry and other relevant employment sectors
- F) Skills Training Examples

Annex 2: National Funding for individual doctoral candidates

Annex 3 EU programmes supporting doctoral candidates (to be completed)

- A) Structural Funds (ESF)
- B) FP7 Marie Curie Actions
- C) LLP Erasmus
- D) Erasmus Mundus
- E) European Research Council (ERC)

Models for doctoral training*(reflecting Member States' contributions and terminology)***A) University-wide doctoral training**

Belgium	<p>In the past decade, all Flemish universities have set up doctoral schools according to the EUA principles. They are autonomous in organizing the doctoral schools and can decide what to accentuate most. Starting from 2011 they will receive a specific funding of 4 mio. EUR from the Flemish government to finance the doctoral education.</p> <p>In Federation Wallonia-Brussels, the doctorate (corresponding to postgraduate studies and lasting a minimum of 3 years) is organised within universities and comprises two parts:</p> <ul style="list-style-type: none"> * a doctoral training (60 ECTS credits) that leads to the conferral of a research training certificate * the work relating to the preparation of a doctoral thesis (corresponding to a standard of at least 120 ECTS), that leads to the conferral of the academic title of doctor after defending the thesis. <p>To apply for a doctorate, the student must submit a draft thesis that is sufficiently defined and obtain the written agreement of a supervisor from a university. The doctoral candidate becomes member of a research team (within a university) affiliated to a thematic Graduate school. There are 21 Graduate Colleges and 50 Graduate Schools in the Federation Wallonia-Brussel.</p>
Denmark	<p>Aarhus University organised its doctoral training at four large PhD schools with a reform in 2010 working closely together on development of talent (in which the doctoral training is closely linked to the Postdoctoral training). Aarhus University's graduate schools are focusing on courses in transferable skills in recognition that increasingly more PhD students will continue their career in the public or private sector instead of in the academic sector.</p>
France	<p>In September 2010, 285 doctoral schools (Ecoles Doctorales) were accredited by the Ministry of Higher Education and Research within the framework of an agreement on objectives between the State and universities (contrats d'établissements). They welcome 70 000 doctoral trainees. Generalized in 2000 and established by-law of August 7th, 2006, doctoral schools help structure the offer of doctoral training, contributing to its visibility and to its attractiveness at national, European and international levels. The doctoral schools provide training and development of doctoral trainees. They offer to future PhD holders a high-level scientific supervision as well as a preparation to occupational integration. A doctoral school federates on a given site the strengths of scientific quality in a consistent set of themes.</p>
Germany	<p><u>Graduate Academies, e.g. Graduate Academy at the University of Jena</u> German Universities have recently established so called Graduate Academies or Research Schools which encompass university-wide</p>

	<p>structures for the training of doctoral candidates (sometimes including offers for MA-students and/or Post-docs). They function as one-stop information and support centres for doctoral candidates. They offer and coordinate various programmes for this target group, provide networking possibilities and ensure good standards in training and supervision.</p> <p>One example is the Graduate Academy at the University of Jena. It prepares early stage researchers for their professional career in science, business and society. Its study programmes combine disciplinary and interdisciplinary topics as well as specially tailored courses in transferable skills and an intensive individual supervision by a team of internationally recognised faculty members. Other German universities (e.g. Bremen, Bochum, Freiburg, Halle, Hannover, Heidelberg, München, Stuttgart, Rostock) have established similar structures.</p>
Hungary	<p>Doctoral training is carried out at higher education institutions at currently 170 thematically organised “doctoral schools” in Hungary. As legal requirement for delivering the doctoral training a Higher Education Institution must provide master training in the given branch of science or art in order to be granted the right to carry a doctoral school, which must be accredited by the Hungarian Accreditation Committee (HAC). The organisation of doctoral studies, the assessment of PhD students and the tutoring and conferring of a doctoral degree are overseen by the doctoral council of the individual HEI. Doctoral studies take 36 months (i.e. six semesters), the workload of the students is at least 180 credits. Obtaining a doctoral degree: separate procedure, 2 years on average by the doctoral candidate. Within a HEI doctoral training is organised in a given discipline, or cooperating disciplines, with minimum 7 core members, a coherent training and research programme, an announced research topics for the students and must be approved (accredited) by the HAC and the HEI Senate.</p>
Ireland	<p>University College Cork (UCC) has developed an extensive range of modules to develop generic and transferable skills of doctoral students, from induction to research through to career planning and commercialisation of research. A particular focus has been on development of communication skills, from modules on scientific writing and publishing (and innovative measures to support such training) to competitions and events where students are challenged to present their work to a non-specialist audience; a very popular on-line doctoral student journal designed to publish non-academic accounts of doctoral student research has also been introduced (The Boolean, at http://theboolean.ucc.ie <http://theboolean.ucc.ie>). These initiatives have then been integrated into a range of structured PhD models within UCC’s Graduate School system, which range from highly structured models in key thematic areas where students undertake a prescribed set of academic and skills-based modules alongside their research (e.g., PhD programmes in Education and Cancer Biology) to more flexible arrangements where the courses taken are tailored to the individual researcher and project area.</p>
Netherlands	<p>Since 2005 the DutchPhD system provides a fixed salary scale, contract periods, and education and supervision plan. From the moment of</p>

	<p>inception, universities started searching for alternative methods of appointing PhD candidates, so as to decrease costs. Some universities currently appoint PhD candidates on the basis of a grant. In doing so, these universities attempt to provide a place for more PhD candidates for the same amount of money, thus improving productivity at the cost of the employment benefits of future PhD candidates. Accordingly, PhD candidates are not entitled to social benefits, such as the right to maternity leave, pension benefits and sickness pay. As a consequence a PhD project could become less attractive compared to other positions.</p> <p><u>Graduate schools</u> As follow-up of the Bologna process many departments with one-year Masters programmes (in Arts and Social Sciences) now provide a separate research Masters programme of two years; for example in Natural Sciences and Health Sciences, and many universities have started to reorganise their teaching departments into separate bachelors and post-graduate programmes. The new ‘graduate schools’ (with very different forms emerging now) provide localised PhD courses, and take away some of the responsibilities of the (national) research schools. However, the recent experience is that both levels (national Research Schools and local Graduate Schools) play a role, in a kind of matrix organisation.</p>
Norway	<p>Norway has established a network of schools between disciplines. Their individual students often are adopted in different doctoral programs in one institution/faculty. The network comes on top to create critical mass of students and teachers/supervisors on a specific research topic/area.</p> <p>The number and the structure of doctoral programs are decided by the individual TEI. While one institution only have one broad program, other institutions have programs by faculty or by theme.</p> <p>Organized doctoral programs were introduced in all fields in 1993. White paper on Research (2008-2009) maintains that all doctoral education must be organized in doctoral programs. The doctoral program shall primarily consist of research activity conducted under academic supervision. A doctoral program includes:</p> <ul style="list-style-type: none"> - Completion of an independent piece of research in active collaboration with the academic supervisor(s) and other researchers; - An approved set of courses or instruction; <p>Participation in active research communities, both national and international;</p> <ul style="list-style-type: none"> - Research dissemination that is closely linked to the thesis in progress. <p>In addition to these basic programs, PhD candidates may apply to participate in network research schools, organized by the institution internally or in cooperation with others, or in national research schools. Participation in network comes on top to create critical mass of students and teachers/supervisors on a specific research topic/area.</p>
Switzerland	<p><u>EPFL Doctoral School</u></p> <p>The Doctoral School of the École Polytechnique Fédérale de Lausanne is the academic home for all of EPFL's doctoral students, distributed across eighteen doctoral programs. Each doctoral program is responsible for</p>

	<p>recruiting doctoral students, organizing their supervision and regular evaluation, and monitoring their progress. The doctoral programs also organize an offer of advanced level courses and create a community based in their scientific domain. The doctoral programs are designed to reach transversally across the EPFL's faculties in order to bring together researchers from different domains.</p> <p>In 2010, the EPFL Doctoral School had over 1,900 enrolled doctoral students, 3,270 applications, and nearly 400 annual graduating PhDs.</p> <p>The majority of EPFL's doctoral students have a dual status as employee, with a contract as doctoral assistant in their research lab on a set salary scale. This employment contract includes a 20% teaching requirement. The EPFL doctorate has a normative duration of four years, with a definitive admission process (including a candidacy exam) at the end of the first year.</p>
UK	<p>University-wide graduate schools for doctoral candidates of all disciplines are common in the UK. The graduate school is responsible for the overall provision of training and development, although this may be delivered centrally or locally within disciplines.</p>

B) National inter-institutional cooperation

Belgium	<p>Flemish doctoral schools have a common platform in the framework of the Flemish Interuniversity Council. Their doctoral courses are open to students from other universities.</p> <p>The 7 universities in the Federation Wallonia-Brussels are associated in 3 Academies. The organisation of doctoral studies is the preserve of each Academy and the doctoral regulation varies from one Academy to another. The Academy and the F.R.S-FNRS are in charge of in inter-institutional cooperation.</p>
Denmark	<p>2010 Universities Denmark established a national framework agreement for two types of PhD courses:</p> <p>1) A model for subject-specific PhD courses where students can participate freely in subject-specific courses at other PhD schools. The providing PhD school's own PhD students have priority of 80 % of the seats whereas external PhD students have 20 %.</p> <p>2) A model for mutual binding co-operation which consists of an open market for subject specific courses. This co-operation is organised in professional networks between the PhD schools' research education programmes to ensure a high academic level and critical mass of participants. so a long-term agreement on an adequate number of relevant courses with a relative even allocation of resources is made.</p> <p>One example is the National PhD education network in Humanities. The faculties of Humanities and the faculties of Theology in Denmark have established a network enabling candidates to participate in PhD courses across the institutions.</p>
Estonia (all examples also could be described in	<p>Doctoral Schools were set up in 2005. In 2009 13 new doctoral schools were elected for the period 2009-2015 for all six public universities.</p> <p>The general goal of is to increase the efficiency of doctoral studies through interdisciplinary, international and national cooperation and to</p>

Chapter C)	<p>improve the quality of tutoring doctoral candidates. In addition of mobility opportunities, winter and summer schools and development of study programme, Doctoral Schools propose transferable and social skills to emphasis interdisciplinary research and enhance cooperation between universities and the private sector. There are special activities for training supervisors, professors and lecturers of doctoral studies. From 2010 people who have interrupted their doctoral studies are welcome to continue and finish their studies – the state is giving them a “second chance” to get free doctoral education. The returners of doctoral studies will participate in Doctoral Schools where they can find supervisors, participate in summer schools, conferences and activities provided by other doctoral schools (incl. mobility).</p> <p>Doctoral schools that can get state support need to involve at least one university and one partner: either another university, R&D institution, public sector organisation or a company. International and national cooperation is required. Doctoral Schools are project based, funded by European Social Fund, total budget of is 16.9 million € for 2009-2015 (- plus at least 5% self-financing).</p> <p>Doctoral Schools in Estonia (2009-2015) cover the following fields: Building And Environmental Engineering, Energy And Geotechnology II, Information And Communication Technologies, Graduate School Of Culture Studies And Arts (GSCSA), Educational Sciences, Economics And Innovation, Estonian Postgraduate School Of Clinical Investigations, Mathematics And Statistics, Behavioural, Social And Health Sciences (DSBSHS), Earth Sciences And Ecology, Graduate School On Functional Materials And Technologies, Graduate School Of Linguistics, Philosophy And Semiotics and a Graduate School In Biomedicine And Biotechnology.</p>
France	<p>The Programming law for Research of April 18th, 2006 allows French higher education and research institutions to establish joint entities designed to give more visibility to French research especially in terms of international rankings.</p> <p>These joint entities called “PRES” and formed as “public institutions for scientific cooperation” (établissements publics de coopération scientifique) ensure the pooling of activities including the coordination of doctoral schools. Examples:</p> <ul style="list-style-type: none"> - PRES may decide to continue dealing with the coordination of doctoral training; this choice was made by the Doctoral College “Lille Nord de France”. - Other PRES choose to further define the funding policy of doctoral training implementation by doctoral schools; they harmonize the doctoral candidate rules of recruitment up to the defence of the dissertation. The PRES “Sorbonne Paris Cité” has chosen this procedure.
Germany	<p><u>International Max-Planck Research Schools</u> are an example for doctorates in cooperation between universities and other research institutions. Within the International Max Planck Research Schools (IMPRS) German and foreign junior scientists are offered the opportunity to earn a doctorate in the excellent research and learning environment of selected Max Planck</p>

	<p>institutes in close collaboration with neighbouring universities and other – sometimes foreign - institutions. Other research organisations like the Helmholtz-Gemeinschaft (HGF) or the Leibniz Association offer similar graduate programmes.</p>
Ireland	<p><u>Dublin Region Higher Education Alliance</u></p> <p>The DRHEA Graduate Education Strand aims to reposition the Dublin region as an International Centre for Graduate and in particular, Doctoral Education, by combining the strengths of the participating institutions. The DRHEA Graduate Education Strand has established an inter-institutional network in the disciplines of, Biomedical Science; Chemistry; Economics; Engineering; Physics and Politics/Sociology and Public Policy. Disciplinary Leaders provide advanced discipline specific taught modules and master classes available to all doctoral students in the alliance.</p>
Ireland	<p><u>Programme for Research in Third Level Institutions (www.heai.ie)</u></p> <p>Launched in 1998, the Programme for Research in Third-Level Institutions (PRTLII) has awarded €1.22 billion (includes exchequer and private matching funds) to date into strengthening national research capabilities via investment in human and physical infrastructure. A core part of this programme is collaboration across the seven universities to develop national graduate schools with structured PhD programmes in thematic areas across all disciplines. The 4-year PhD programmes facilitate inter-institutional training in generic and discipline-specific skills and, in some cases, provide laboratory rotations, internships and industry placements. Some examples of the thematic programmes funded by this scheme include Digital Arts & Humanities, Engineering, Natural Sciences, Molecular Medicine, Inflammation, Electricity Research and Physics. The Universities have signed a 4th level Agreement to facilitate the sharing of modules and mutual recognition of ECTS and quality.</p> <p><u>Molecular Medicine Ireland (MMI)</u></p> <p>Molecular Medicine Ireland was established by the National University of Ireland Galway, the Royal College of Surgeons in Ireland, University College Cork, University College Dublin and Trinity College Dublin and their associated academic hospitals, as a research partnership to accelerate the translation of biomedical research into improved diagnostics and therapies for patients. MMI was formed in response to the need to create a critical mass of excellence in molecular medicine research and <u>doctoral education</u> in Ireland and to deploy a clinical research infrastructure to facilitate medicine into better healthcare provision. It was formally incorporated as a not-for-profit company in April 2008 and is funded under the Higher Education Authority's Programme for Research in Third Level Institutions (Cycles 4 and 5), the Health Research Board, the Wellcome Trust and the EU.</p>
Italy	<p>In Italy, networks among Universities are organized to improve the</p>

	quality of doctoral training in specific programmes and to increase the critical mass of doctoral candidates. Mobility of the candidates among the participant Universities is established on the basis of specific agreements.
Netherlands	<u>Research schools</u> In the early 1990s national research schools became the central organisations for research. In 1992 the Royal Netherlands Academy of Arts and Sciences was asked to create a specific body (Evaluation Committee for Research Schools/ECOS) to accredit and – in rounds of five years - reaccredit these research schools. Universities attached great value to these evaluations. Most of the research time of senior scholars, and all regular PhD projects had to be incorporated into these research schools. Often many other types of PhD projects also participated in these schools (bursaries, ‘sandwich’ PhDs, practitioners’ PhDs, self-financed PhDs). Currently, there are about 100 (re)accredited research schools in the Netherlands, some of them also with research partners in Belgium (Flanders).
Norway	In 2007 a pilot program of national research schools was established. The aim was to improve quality of PhD training and counteract fragmentation, by creating networks of cooperating research milieus. There are now six thematic research schools within this program, However institutions have also taken initiative to establish their own national networks.
Portugal	Portugal currently has 24 Ph.D programs in collaboration/association between two or more universities or other institutions such as research institutes. In 2010/2011 this number will increase to 27. The programs focus on a wide number of disciplinary areas, including e-planning, Education sciences, Biology, Agricultural sciences, higher education studies, ICT, digital media, accountability or history.
Switzerland	<u>Doctoral Programmes of the Rectors’ Conference of the Swiss Universities CRUS</u> For 2012-2016, the Rectors’ Conference of the Swiss Universities (CRUS) has launched, complementary to existing institutional doctoral schemes, a national programme aiming at offering young scientists inter-institutional programmes that enable research networking and better integration. CRUS’ long-term objective is to offer appropriate training schemes for the majority of doctoral students. The doctoral programmes that will be funded have to correspond to the Joint Position by the Swiss universities on the Doctorate ²⁵ and to fulfil a set of criteria regarding supervision, inter-institutional cooperation as well as to the programme’s research topic. The responsibility for the implementation modalities of their doctoral programmes lies with the individual universities. http://www.crus.ch
Switzerland	<u>Doctoral Programmes Western Switzerland University Conference CUSO</u> Building on earlier cooperation in 2005 the Conférence universitaire de Suisse occidentale (CUSO) began to set up joint doctoral programmes (as supportive and complementary structures) designed to provide doctoral students with in-depth scientific and methodological courses and seminars, and to help them acquire and perfect their transversal and

²⁵ See the Joint Position Paper by the Swiss Universities on the Doctorate, <http://www.crus.ch/dms.php?id=6872>.

	<p>transferable skills. The programmes also offer many occasions for networking and socialization: as early-stage researchers, doctoral students need to become well-acquainted with the scientific community in their field, including its rules and values.</p> <p>CUSO funds are available for purposes of coordination, inviting speakers from abroad, organizing residential and in-house seminars, and reimbursing students' travel costs from their universities to the sites of seminars.</p> <p>As of January 1, 2011 there were 22 programmes in operation, with 1500 students enrolled. http://www.cuso.ch/programmes-doctoraux.</p>
Switzerland	<p><u>StartingDoc Programme</u></p> <p>StartingDoc started in 2008 and is a „group-mentoring“ programme addressed to women at the very beginning of their academic career. It concerns beginner PhD students from the universities of western Switzerland and the Federal Institute of Technology Lausanne (EPFL) and is financed by the Federal Equal Opportunity at the Universities Programme. StartingDoc offers PhD students useful tools to succeed through their academic path. The programme is open for all disciplines and therefore it focuses on the structural aspects, which are required to achieve a PhD thesis, such as milestones of the academic path, researcher rights, work management, network building and publications. http://www.unil.ch/mentoring</p>

C) Thematically organised doctoral training

Austria	<p>The Austrian Science Fund (FWF) offers a programme for the funding of structured doctoral programmes (“Doktoratskollegs”) at research institutions that are entitled to award a doctoral degree. These are training centers for highly qualified doctoral candidates from the national and international scientific community. A “Doktoratskolleg” is formed as a result of a joint initiative by several scientists or scholars whose research is of internationally leading standard, and is based on a clearly defined research programme. The doctoral programmes have close cooperation with an existing large-scale research programme. Interim reviews every four years decide on continuation of funding of the doctoral programme, with a maximum length of 12 years. Doctoral candidates are employed on work contracts with full social coverage, the positions are advertised internationally. The programmes provide for a stay abroad and offer transferable skills training.</p>
Austria	<p>Several Austrian universities have developed structured doctoral programmes similar to those in the FWF model. For example the University of Vienna supports twelve structured doctoral programmes (“Initiativkolleg”) for 3 years. The selection of the programmes is subject to strict quality assurance the assessment is made by international peers. Admission to an “Initiativkolleg” is competitive and based on an international call for applications. Doctoral candidates are employed by the university, with full social coverage. They work together in a research field, thereby focusing on their topic but at the same time being part of a comprehensive research project, and thus enabling them to network on an</p>

	international and often interdisciplinary level. They are supervised by a team of top scientists.
Belgium	<p>The Flemish universities fund thematic and interdisciplinary Doctoral Schools. These Schools offer training (including transferable skills) to doctoral candidates. They link their doctoral programmes to labour market outcomes. The Doctoral Schools also engage (inter)nationally with similar initiatives.</p> <p>The thematic and interuniversity Graduate schools are associated in Graduate colleges attached to the Fund for Scientific Research (F.R.S.-FNRS). 21 Graduate colleges (écoles doctorales près le F.R.S.-F.N.R.S.) are in charge of hosting, coordinating and promoting the creation of thematic, interuniversity, interdisciplinary and international Graduate schools. Currently there are 50 recognised Graduate Schools.</p>
Denmark	<p><u>University of Southern Denmark, The Faculty of Engineering</u> All PhD students at the Faculty of Engineering are enrolled in the PhD school which is subdivided into six research training programmes:</p> <ul style="list-style-type: none"> o Applied Mathematical Modelling o Energy and Environmentally Efficient Technologies o Functional Materials and Nanotechnology o Information and Communication Technologies o Product Design and Innovation o Robotics <p>Each programme is interdisciplinarily anchored in a research training programme committee (RTP Committee). The RTP Committee's role is to advise the PhD School in academic matters, as well as to academically assist the research training programmes in terms of construction, operation and development of the academic studies within each field.</p>
Denmark	From 2011 PhD-education in biomedicine and health sciences takes place within the framework of Research Education Programmes specific for relevant research areas. They are established locally by the Faculties of Health Sciences, but cooperate nationally in each area within the framework of National Research Education Networks and aim to ensure Ph.D.-students' access to high-quality courses and relevant research networks.
France	<p>Doctoral schools divide up into wide disciplinary fields, themselves subdivided into research expert groups: Mathematics and their interactions (75 doctoral schools); Physics (164 doctoral schools); Earth science and the universe, space, chemistry (149 doctoral schools); Biology, medicine and health (315 doctoral schools); Social sciences and Humanities (958 doctoral schools); Sciences in society (419 doctoral schools); Engineer sciences (343 doctoral schools); Sciences and technologies of information and communication (324 doctoral schools); Agronomic and ecological sciences, animal, vegetable and food research production, agronomy, (146 doctoral schools).</p> <p>A Doctoral school may cover several fields. Therefore the doctoral school may be mono-disciplinary or multidisciplinary. Examples: The doctoral school "Life sciences and the Health" (doctoral school n° 154) is mono-disciplinary and it congregates all the research laboratories</p>

	<p>in biology-health of both universities Bordeaux 1 and 2. The doctoral school congregates 50 research laboratories. The delivered doctoral degree has the following specification: " Sciences, Technology, Health " and includes the following 12 options: biochemistry, Biocomputing, Cellular Biology and Physiopathology, Plant biology, Epidemiology and Public health, Genetics, Chemistry-Biology Interfaces, Microbiology, Neurosciences, Nutrition, Oenology, Pharmacology.</p> <p>The doctoral school "Environment and Society" (doctoral school n° 377) of the University of Corsica Pasquale Paoli, highly multidisciplinary, covers broad areas of research involving various teams that congregate the research fields of labelled research entities. These topics deal with environmental sciences, environment and society, legal aspects of patrimony, capital and on places, identities, spaces, business. Directory of the DS is available at: http://appliweb.dgri.education.fr/annuaire/ed_ur.htm</p> <p><u>Frontiers in Life Sciences "FdV" Phd programme</u>²⁶</p> <p>The international interdisciplinary PhD programme "Frontiers in Life Sciences" (FdV, Frontières du Vivant), aims at promoting research projects centered on an understanding of life requiring the blending of different disciplines. The graduate school recruits PhD candidates that were trained in any discipline (natural sciences, humanities, medicine...) worldwide. Partner institutions and foundations ensure the long-term continuation of the program and the international character of the recruitment. In addition, special budget will be devoted to promote students scientific life. The FdV PhD programme accommodates students and visiting professors at the heart of Paris, in FdV-dedicated teaching facilities organized to maximize intellectual exchanges and is part of the "Liliane Bettencourt program" created and funded by the Bettencourt-Schueller Foundation.</p>
Finland	<p><u>Doctoral Programmes</u></p> <p>Structured doctoral programmes were established in Finland in 1995. The system is based on competitive funding where doctoral programmes apply at two-year intervals for 4-year fellowships (funded by the Ministry of Education and Culture) and operating grants (funded by the Academy of Finland). The system supports disciplines with high scientific quality research groups. The majority (85%) of the programmes funded by the Ministry and the Academy form national networks between universities and other partners thus efficiently linking the doctoral candidates, researchers, professors and the whole research infrastructure in the field together.</p>
Germany	<p><u>DFG Research Training Groups ("Graduiertenkollegs")</u>²⁷</p> <p>Research Training Groups are established by universities to promote young researchers. They are funded by the DFG for a period of up to nine years. Their key emphasis is on the qualification of doctoral researchers within the framework of a focused research programme and a structured</p>

²⁶ <http://www.fdv-paris.org/en/ecole-doctorale-fdv/>

²⁷ http://www.dfg.de/en/research_funding/programmes/list/index.jsp?id=GRK

Germany	<p>training strategy. Research Training Groups with an interdisciplinary approach are welcome. The aim is to prepare doctoral researchers for the complexities of the job market in science and academics and simultaneously to encourage early scientific independence.</p>
	<p><u>Graduate Schools (as part of the German Excellence Initiative)</u> Graduate Schools serve as an instrument of quality assurance in promoting young researchers and are based on the principle of training outstanding early stage researchers within an excellent research environment. Graduate schools thus offer ideal conditions for doctoral candidates within a broad scientific area and, as integrative institutions with international visibility, they encourage the doctoral candidates to be active members of their academic and social communities. Graduate schools extend beyond DFG Research Training Groups and differ from them substantially. They should also contribute to the strategic development of the university.</p>
Israel	<p>The Ph.D. is by far the most common of the various doctoral degrees. Seven universities have been authorized by the Council for Higher Education to award this degree. Doctoral programs extend over a minimum of two years after completion of the master's degree, but are generally completed only after four or more years. Four of Israel's 7 research universities have graduate schools.</p> <p>The Direct Doctoral Program is intended for exceptional students who have an outstanding result in their bachelor's degree. The first year of the program is an accelerated master's program. If high achievement is maintained, the student may bypass the second year of the master's program and proceed directly to doctoral studies.</p> <p>The <u>Feinberg Graduate School</u> at Weizmann Institute was founded in 1958. Studies are conducted within research schools. For each school a director coordinates all activities in the relevant field of study. These include: guidelines for academic requirements, courses, laboratory work, admission of students, and evaluation of their progress in both research and studies. FGS awards MSc and PhD degrees and trains students for senior positions in academia, research, and industry. All students are directly involved in the research conducted at the institute, and receive scholarships so they can devote their time to research and study. Study programs are offered in five major fields: Physical Sciences, Chemical Sciences, Life Sciences, Mathematics and Computer Science and Science Teaching. There are over 1,000 students, with a student teacher ratio of 4:1. The official language of instruction of the School is English. This enables foreign students to participate fully in all of the School's programs.</p> <p>The <u>Kreitman school of Advanced Graduate Studies</u> serves as the administrative framework for graduate and post-graduate students at Ben-Gurion University of the Negev. In addition to providing a range of services to these students, the school directs its efforts toward attracting outstanding candidates for advanced studies and increasing the overall proportion of graduate students in the total student body. The Kreitman School's emphasis is on academic excellence. A new program, the Kreitman Foundation Fellowships, has been inaugurated to attract Ben-</p>

	<p>Gurion University's graduate and post-graduate students of exceptional excellence to pursue their studies.</p> <p><u>Graduate School at the Technion</u> was officially established in 1956. Courses of study and research, leading to advanced academic degrees, are offered in all of Technion's academic units. In the academic year 1999/2000 more than 3500 students were enrolled in The Graduate School.</p> <p>The <u>Graduate School at the Bar Ilan University</u> is currently being established and will coordinate master and doctoral programmes.</p>
Italy	<p>While no nationale rules for the organisation of doctoral schools have been defined yet by national rules, some Italian Universities set up schools to coordinate structured doctoral programmes following the "Salzburg principles". These follow two models: thematic schools (mainly in big Universities) and University Doctoral Schools (where programmes in different fields are coordinated in a single university structure). Examples of the second model are at the Universities of Camerino, Ferrara, Macerata, Molise, Piemonte Orientale, Roma II and Siena which also provide transversal activities to acquire transferable skills.</p>
Ireland	<p><u>Programme for Research in Third Level Institutions (www.heai.ie)</u></p> <p>For example, INSPIRE – Integrated Nanoscience Platform for Ireland is a consortium of eight Irish third level institutions with international leading research capability in nanoscience and nanotechnology. It has funding of over €1m. INSPIRE is a collaborative framework for nanoscience research and graduate education. It provides shared access to advanced instrumentation, graduate courses and new strategic research partnerships.</p> <p><u>Dublin Chemistry Graduate School</u></p> <p>The Dublin Chemistry Graduate School is a collaboration between Trinity College Dublin and University College Dublin. With over forty team leaders, Dublin Chemistry offers young scientists the opportunity to conduct wide ranging high level research in areas such as synthetic and computational chemistry, nanochemistry, advanced materials, biological and medicinal chemistry and much, much more. Importantly, this research is supported by advanced level chemistry graduate courses and training in instrumental techniques, as well as courses in communication, presentation and how to carry out effective research. The programme is organized through the Dublin Chemistry Management Committee which meets regularly, is particularly receptive to student input, and is supported by the annual meeting of the Dublin Chemistry Steering Group. Dublin Chemistry is also working with the other Schools of Chemistry in the greater Dublin region to provide graduate courses through the Dublin Region Higher Education Alliance in Chemistry</p>
Norway	<p>PhD education takes place within doctoral programs. In addition, PhD students may be connected to thematically organized doctoral schools.</p>

	<p>These schools may be organized as a network model, of individual PhD candidates, tutors, and other senior staff across institutions (National doctoral schools).</p> <p>Other schools are organized within particularly strong research groups or centres of excellence (Flagship model).</p>
Spain	Some Spanish universities have structured their doctoral training in thematic doctoral programmes. Some examples: Universidad Carlos III, Universitat de Girona, Universidad Santiago de Compostela, Universidad Pompeu Fabra.
Switzerland	<p><u>Life Science Zurich Graduate School</u></p> <p>For example, in areas of joint complementary competence, ETH Zurich operates joint doctoral programmes with the University of Zurich: Life Science Zurich Graduate School, with partial involvement of the University of Basel (Plant Science). http://www.lifescience-graduateschool.ch/</p>
UK (Scotland)	<p><u>Scottish Universities Physics Alliance (SUPA)</u></p> <p>The SUPA Graduate School was set up in early 2006. It runs an annual intensive postgraduate training programme²⁸ for Scottish physicists at eight Scottish Universities. The intense programme consists of 60 courses across seven technical themes. In addition, the Graduate School programme includes inter-theme courses and transferable skills development - SUPA makes use of existing departmental, university and Research Councils UK generic skills training.</p>

D) International cooperation

Universities Cambridge, Delft, Grenoble, KIT, Leiden, LMU München	European Research School Physics (currently being set up)
Universities Pompeu Fabra, LSE, EUI, Catholique de Louvain, École des Hautes Études en Sciences Sociales, Bonn	<p><u>Graduate programme in Economics, Finance and Management</u>²⁹</p> <p>This joint PhD programme is geared to develop students' research skills and independence of thought. The purpose of the PhD degree programme is to prepare students of exceptional talent for careers in research and teaching at the world's leading academic institutions, research centres, consulting or financial firms, and international organisations. This program is a partner in the European Doctoral Program (EDP) in Quantitative Economics.</p>
Universities Autònoma de Barcelona, UCL,	<p><u>International doctorate in Economic Analysis</u>³⁰</p> <p>This PhD programme is part of the European Network for Training in Economic Research (ENTER). In addition to spending time at their home institution, doctoral candidates in the program spend one or two semesters</p>

²⁸ http://www.supa.ac.uk/Graduate_School/courses/courses.htm

²⁹ www.econ.upf.edu/eng/graduates/gpem/

³⁰ <http://idea.uab.es/>

Mannheim, Libre de Bruxelles, Stockholm, CentER (Tilburg), MPSE (Toulouse), Carlos III de Madrid	<p>in one or two institutions of the network, where they are treated on the same footing as local candidates. Depending on their previous work, they can either take courses or pursue their dissertation research under the additional supervision of faculty at the host institution.</p>
Zaragoza Logistic Centre, MIT, Universidad de Zaragoza	<p><u>The MIT-Zaragoza International Logistics Program</u>³¹ This programme offers a unique research and education partnership that brings together the supply chain interests of academia, industry and government – all linked to the development of the largest logistics park in Europe. The program was established in 2003 by the MIT Center for Transportation and Logistics (CTL), the University of Zaragoza, the government of Aragón, industry partners, and the PLAZA logistics park in Zaragoza. The University of Zaragoza awards the PhD in Logistics and Supply Chain Management. Doctoral candidates also receive a certificate from MIT for their stay at MIT.</p>
Denmark	<p><u>Sino-Danish Chinese Industrial PhD programme</u> The purpose of the industrial PhD Programme for China is to further the development of the Danish knowledge intensive business community by strengthening the relationship between Danish and Chinese science and technology communities. The Industrial PhD project stretches over three years conducted in cooperation between a private company, a university and the Industrial PhD candidate. The student is employed by the company and enrolled at the university and divides his or her time between the two workplaces. The programme includes subsidies to cover the student s salary, travel expenses and tuition. The Danish Agency for Science, Technology and Innovation has so far granted around DKK 13 mil. to the programme specifically aimed at Chinese PhD students.</p>
Denmark	<p>The Danish Ministry for Science, Technology and Innovation has engaged in partnership agreements with the H-STAR Centre (Human Sciences & Technologies Advanced Research Institute) at Stanford University and the research network CITRIS (Center for Information Technology in the Interest of Society) at UC Berkeley, UC Davis, UC Merced and UC Santa Cruz. These Partnership agreements are initiated as part of the Danish globalization strategy and aim at strengthening possibilities for Danish Universities to participate in international research networks. They include the option to buy visiting researcher slots, giving Danish researchers and PhD-students the possibility to apply for a visiting scholar status for up to six months at either of the universities mentioned above. The Danish Ministry for Science, Technology and Innovation launches annual calls for applications for visiting scholarships.</p>
Denmark, Norway, Estonia,	<p>NordForsk, an organisation supporting research under the Nordic Council of Ministers, facilitates co-operation at Nordic level between national research schools the Nordic countries. The intention is to encourage</p>

³¹ www.zlc.edu.es/default.aspx?info=000011

Iceland, Latvia, Lithuania, Finland, Åland Islands, Faroe Islands	mutual exchanges of ideas and competences, to promote mobility and to increase coherence in the Region's researcher training. Research schools from at least two Nordic countries must be involved.
France	<p>The French higher education institutions take part in joint-supervised international doctoral training (co-tutelle internationale de thèse). Examples:</p> <ul style="list-style-type: none"> - In September 2010, thirteen institutes and Universities, launched the "International Relativistic Astrophysics Doctorate Program" project (IRAP). This program, the only project in fundamental physics and astrophysics in Europe, selected in the frame of Erasmus Mundus Doctorate leads to a common doctoral degree to all thirteen institutions [université de Savoie, l'université de Nice Sophia Antipolis, Observatoire de la Côte d'Azur ,Shanghai Astronomical Observatory(China), Free University of Berlin et AEI Postdam (Germany),Tartu Observatory (Estonia), Stockholm University (Sweden), University of Ferrara, University of Rome La Sapienza, International Center for Relativistic Astrophysics Network, (Italy); Brazilian Centre for Physics Research (Brazil), Indian Centre for Space Physics (India)]. <p>International partnerships can also be structured in European or International colleges:</p> <ul style="list-style-type: none"> - At the University of Strasbourg, the European Doctoral College gives thirty doctoral trainees the opportunity to prepare joint-supervised doctoral research projects involving the University of Strasbourg and a university or research organisation of a country chosen by the doctoral trainee. - The PRES "Université européenne de Bretagne", with its International Doctoral College, whose mission is to share and coordinate international doctoral training has signed several agreements with higher education institutions in Brazil. The joint-supervised doctoral research projects deal with cell and molecular genetics, marine environment science and cross-language research on memory, identity and territory
Germany	<p><u>DFG International Research Training Groups</u>³²</p> <p>International Research Training Groups provide opportunities for joint doctoral training programmes between German universities and universities abroad. The research and study programmes are jointly developed and supervised. Doctoral students in the programme complete a six-month research stay at the respective partner institution.</p>
Ireland Trinity College Dublin, Addis Ababa University	<p><u>International Doctoral School in Global Health (INDIGO)</u> <u>Building capacity in Health Sciences in Sub-Saharan Africa</u></p> <p>The International Doctorate in Global Health (INDIGO) is the first truly international doctoral programme in global health. The programme is offered by the International Doctoral School in Global Health, and</p>

³² www.dfg.de/en/research_funding/programmes/coordinated_programmes/research_training_groups/international_rtg/index.html

<p>(Ethiopia), University of Malawi, Ibadan University (Nigeria), Makerere University (Uganda), Columbia University (USA), Harvard Medical School (USA) and UK Cochrane Centre (UK).</p>	<p>coordinated by the Centre for Global Health at Trinity College, Dublin. Participating partners include Addis Ababa University (Ethiopia), University of Malawi, Ibadan University (Nigeria), Makerere University (Uganda), Columbia University (USA), Harvard Medical School (USA) and UK Cochrane Centre (UK). Our programme offers a unique opportunity for students from diverse backgrounds to study at some of the world's leading universities and to conduct research in an African setting under an international panel of supervisors. The programme is aimed at health professionals from any part of the world. INDIGO is designed to produce leaders in global health research, policy and practice. The main focus of INDIGO is on strengthening health systems in Africa, and three areas of research will be promoted: maximising human resources for health; managing communicable diseases; promoting equitable and inclusive access to health</p>
<p>Italy</p>	<p>Aiming at internationalization of doctoral training, some Italian doctoral schools have calls for admission open to candidates from any country and offer programmes and fellowships to applicants from least developed countries. One example of international cooperation in an interdisciplinary doctoral is the University of Camerino programme "Malaria and Human Development", cofunded by WHO. It includes training on life sciences, health economics and social sciences and attracts candidates from countries where malaria is endemic; institutions in these countries are partners in the cooperation and provide supervision of the field work and future placement for doctorate holders.</p>
<p>Norway</p>	<p>Some universities have established agreements of "Cotutelle de thèse" with French universities according to the model described by Switzerland.</p>
<p>Portugal</p>	<p>International Partnership programmes in specific fields between Portuguese universities and institutions abroad (MIT, Carnegie Mellon, University of Texas).</p>
<p>Switzerland</p>	<p><u>Cotutelles de thèse</u> A "Cotutelle de thèse" is a bi-national doctorate with a supervisor both in the candidate's home university and in a partner university abroad, leading to a joint diploma (either a diploma issued jointly by the two institutions or two separate diploma, specifying the nature of the doctorate as a "cotutelle de thèse"). Swiss national authorities provide funding for "Cotutelles" between Swiss universities and universities of neighbouring countries (Austria, France, Germany, Italy) in order to cover the travel and residence expenses of both the doctoral candidate and his/her supervisor. Not all universities make use of this possibility. http://www.crus.ch/information-programmes/cotutelles-de-these.html</p>
<p>EU</p>	<p><u>Marie Curie Initial Training Network</u> Initial Training Networks (ITN) offer early-stage researchers including doctoral candidates the opportunity to improve their research and transferable skills, join excellent research teams and enhance their career prospects. At least three participants from different countries join together to propose a coherent research training programme for an ITN. The participants can be universities, research centres, companies (large or</p>

	small) or any other socio-economic actors. Any research field in the humanities or science may qualify for ITN funding – provided that there is an element of mobility across national borders. The funding covers recruitment and employment of researchers, training in research and transferable skills, as well as networking activities, workshops or conferences.
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E) Doctoral training in cooperation with industry and other relevant employment sectors:

Belgium	<p>The Baekeland programme funds doctoral projects that are executed at a Flemish university in close cooperation with a company. The PhD candidate is supervised jointly by an academic and an industrial supervisor and spends a considerable amount of time at the company. Projects are cofunded by the company and the orientation of the research project should be strategic.</p> <p>The Federation Wallonia-Brussels is supporting transversal trainings that can be developed with the private sector within Graduate Colleges. Wallonia also supports the doctoral trainings in cooperation with industry through the FIRST SPIN-OFF scheme in order to improve the scientific and technological potential of the research units and to train the future managers in the fields of emerging technologies. The scheme has been set up with a view to inciting the university researchers to develop new industrial products.</p>
Denmark	<p><u>Industrial PhD programme</u></p> <p>An Industrial PhD project is a three-year business focused PhD project where the student is hired by a company and enrolled in a university at the same time. The company receives a monthly wage subsidy of DKK 14,500 while the university has its expenses for supervising etc. covered. The PhD student works full time on the project and divides his or her time equally between the company and the university. In 2010, DKK 134 mil. has been allocated (as opposed to DKK 104 mil. in 2009) for new Industrial PhD projects. Accordingly, it is assumed all qualified applications from the private sector will receive funding. Last year, more than half of all applications were approved.</p>
Estonia	<p>The "Training doctoral students in cooperation with businesses" programme is intended to assist innovative companies who successfully apply research results, technology and professional design in their services and products by funding the creation of supported doctoral student places. In order to be admitted as a partner to the programme, the business must be engaged in a development activity that possesses good application prospects and be willing to conclude an employment contract with the doctoral student and to pay at least the legal minimum wage to that student. The partner universities must find a suitable partner and will be responsible for the quality and progress of the supported students' studies. Eligible expenditures include the student's tuition fees, a monthly stipend and the remuneration of the student's co-supervisor at the company. Supported places will be funded on the same terms that apply in</p>

	<p>relation to doctoral studies under the funding scheme established in Estonia in relation to government funded provision of higher education. This activity intended to foster development in the priority areas specified in Estonia's national RD&I strategy (information and communication technology, materials technology, environmental technology, biotechnology, power engineering and health). Eligible partners are Estonian universities who are offering accredited PhD programmes in the aforementioned priority areas. This training model started 2008 and there is no graduations yet (in Estonia doctoral programmes last 4 years). Funded by European Structural Fund, total budget 2,6 million € for 2008-2015.</p>
France	<p>The Programming law for Research of August 7th, 2006 on doctoral training includes several actions aiming at bringing together doctoral training and socio and economic sectors. The reform of the training frame includes two major trends regarding doctoral training cooperation with industry and other relevant employment sectors</p> <ul style="list-style-type: none"> - Refocusing doctoral programs on the preparation to occupational integration; - Better link doctoral training and R&D in socio and economic sectors. <p>Some 1200 doctoral trainees defended, in 2009-2010, a dissertation through the CIFRE programme.</p> <p>The CIFRE programme (Conventions Industrielles de Formation par la Recherche) which is a partnership between French industry or other relevant employment sectors, a research laboratory and a doctoral candidate. During a three- year contract with the company or other private employer, the doctoral trainee will benefit from a high level of scientific supervision that will help him or her write and defend a PhD dissertation while contributing to research activities. The programme is managed by ANRT (Association Nationale de la Recherche Technique).</p>
Germany	<p>Some R&D intensive companies have developed close collaborations with universities for the sake of training of the future generation of leading researchers. They fund the positions for the doctoral researchers and provide space in their labs for them to carry out their research. The doctoral researchers belong to a university, are formally employed by it. They carry out a project defined by the company, but following strict academic standards.</p> <p><u>KIT/Daimler</u> is one example of such a joint graduate school of the Institute for Technology in Karlsruhe (KIT) and the Daimler AG (as part of the Project House e-drive), financed by Daimler and funded by the Ministry for Science, Research and Art Baden-Württemberg. During the four year doctorate, the candidates spend most of their time doing research at the KIT but also work in Daimler AG research and development departments. The programme comprises an obligatory 3 months stay at a company or research institution abroad and is open to other interested industrial partners.</p> <p><u>Doctorate in cooperation</u> with Audi is another example where more than 80 doctoral candidates take part in the research projects (in technical studies as well as humanities) funded by Audi in close cooperation with 10 universities. The overall aim of the projects is to expedite the transfer</p>

	of knowledge between research and industry as well as the promotion of young researchers.
Hungary	<p>There are R&D intensive companies in Hungary which have established close, long-lasting cooperation with universities playing an active role in PhD training.</p> <p><u>ERICSSON – BME, ELT:</u> Ericsson Telecommunications Hungary (ETH) has developed close collaborations with several departments at two major universities in Hungary: ELTE (Eotvos Lorand University) and BME (Budapest University of Technology and Economics). In this cooperation students and their supervisors can work on industrially motivated problems mainly within MSc and PhD programmes. Ericsson also offers internships, where PhD students are contracted for a period of time, and they can work closely together with researchers of Ericsson, mostly on Ericsson-internal or EU projects. These university cooperations started almost 20 years ago, and from these cooperations almost 80 PhDs have been completed since foundation. Ericsson also actively takes part in education by holding lectures and providing help in working out details of various subjects. Recently the collaboration has been significantly extended in the fields of software, hardware and microwave networks.</p> <p><u>Robert Bosch Department of Mechatronics:</u> The University of Miskolc and the Hungarian Bosch Companies founded the Robert Bosch Department of Mechatronics in 2005. The target of the cooperation is to support practical oriented education and research activities in the engineering sciences placing special emphasis on the wide range applications of mechatronics.</p> <p>Within the frame of the cooperation seven industrial Ph.D. programs are currently in progress. Three of them are performed at Bosch, while four of them at the University.</p> <p>The main benefits of the cooperation are:</p> <ul style="list-style-type: none"> - to create harmony between the theoretical and practical sciences; - to move towards more practical oriented education and training; - to have better and long-lasting collaboration between University and Industry.
Ireland	<p>The <u>Enterprise Partnership Scheme</u> is an innovative initiative through which Irish Council for Science Engineering and Technology (IRCSET) links with private enterprise and eligible public bodies to award co-funded postgraduate scholarships and postdoctoral fellowships to the most promising researchers in Ireland. Benefits include: mentoring from industry experts, placement opportunities, exposure to commercially orientated research environment, transferable skills, relationship with a potential future employer. The industry partner provides 30% of the funding. There are over 160 companies involved in the funding of 350 doctoral candidates.</p>
Italy	<p>The Italian Ministry of Education, University and Research has a yearly call for doctoral fellowships in topics related to industrial research open to all Italian universities hosting doctoral courses / programmes on these topics. The requirements for fellowship assignment include agreements</p>

	with foreign Universities for research collaboration, PhD-cotutelle programmes, and geographical and intersectoral mobility plans for the admitted candidates. Some universities additionally attract funding from private companies and non-academic institutions to increase the number of fellowships on the most innovative industrial-research programmes.
Luxembourg	The AFR (Aides à la Formation-Recherche) PhD grant scheme (www.afr.lu) has a specific funding line in support of public-private partnerships (AFR-PPP). In the framework of AFR-PPP, industrial PhDs that are carried out by a private company in collaboration with a HE institution are funded. The industrial partner has to be based in Luxembourg, while the HE institution may be located in another country. The industrial partner has to obtain an accreditation for research activities by the Ministry of Economic Affairs, in order to be eligible for AFR-PPP support. The grant covers the costs for a work contract of the doctoral candidate, to be concluded either by the industrial partner or by the HE institution, depending where the major part of the work is performed. In addition, a training allowance over the full grant period of 3-4 years is allocated to each fellow. Calls for proposals are issued twice per year by the National Research Fund in spring and autumn. Proposals are selected on the basis of international peer review by an expert panel. The provision of transferable skills forms an integral part of the scheme.
Norway	<p><u>Industrial PhD program</u></p> <p>An Industrial PhD project is a three-year business focused PhD project where the student is hired by a company and enrolled in a university at the same time. The research project is conducted in cooperation between a private company, an Industrial PhD student and a university. As a supplement to the research community in either the university or the company, a public research institution can be attached.</p> <p>Companies that enter into a collaboration agreement under the Industrial PhD scheme receive an annual grant from the Research Council equal to maximum 50 % of the established current rates for doctoral research fellowships for a three-year period. The PhD student works full time on the project and divides his or her time equally between the company and the university. Universities and students of all nationalities may be accepted. All students enrolled in the program have once a year been invited to a special business course by the Research Council.</p>
Portugal	Bolsas de Doutoramento em Empresas (BDE, Doctoral degree grants in enterprises) . See Annex 2 below
Switzerland	Many of the research groups at Swiss universities, notably at the two Federal Institutes of Technology, maintain close collaboration with industrial partners. Various models of industrial doctorates are possible; what is important for the success of an industrial PhD is a common understanding of all partners implied and an active involvement of all partners all along the dissertation work.
Slovenia	<p><u>Young researchers in enterprises</u></p> <p>The measure aims at establishing a bridge between the research sphere and enterprises. This programme contains three kinds of financial contributions: to the monthly income of a young researcher, to the</p>

	<p>mentorship allowance and to the actual cost of research. The aim of the measure is to create high quality human potentials in the fields where Slovene economy needs new knowledge for developing high-tech and innovative products, technologies or services, to strengthen and to stimulate creation of research teams in industry and economy (SME involved), to establish efficient cooperation among research institutions, universities and industry, to stimulate interdisciplinary nature of post-graduate studies. Applications may be submitted by enterprises and technology centres, the immediate beneficiaries are young researchers-postgraduate students, there is an age limit of 35 years for candidates. There are special requirements regarding mentorship for young researchers and for their full-time engagement in research activities.</p>
Spain	<p><u>Talent Empresa</u> is an industrial PhD programme promoted by the Regional Government of Catalonia. The programme offers funding for the incorporation of researchers in companies and technological centres as long as they pursue industrial research while being enrolled in a doctorate at one of the Catalan universities. Open to all nationalities, the program offers employment contracts with full social security coverage. The research training is conducted mainly in the industrial partner with the joint supervision of university staff.</p>
UK	<p>The UK Research Councils fund <u>CASE studentships</u>, Engineering Doctorates and other forms of collaborative PhD training which may be jointly funded by a funding partner outside HE. Industry, business and other research partners also provide fully-funded PhD studentships. In most collaborative awards the student will spend time working on the premises of the research partner.</p>
UK	<p><u>Special case: Professional doctorates</u> These doctorates are offered in a variety of professional fields including engineering (EngD), nursing (DNursSci), veterinary medicine (VetMD), education (EdD), business administration (DBA) and clinical psychology (DClinPsy). As for the traditional PhD, candidates are required to produce original knowledge; but with the additional proviso that this should make a significant contribution to professional practice. Professional doctorates may also be combined with a taught element and, instead of requiring a thesis, may offer the option of producing a collection of extended assignments. In many cases, professional doctorates are designed and delivered in collaboration with employers and professional bodies, and are strongly linked to the needs of a particular sector. In the case of the EngD, for example, doctoral students conduct PhD-equivalent research whilst also undertaking taught business courses and working alongside an industrial partner. This kind of ‘experience-led’ learning has proved extremely popular with employers.</p>

F) Skills Training Examples

The skills training ideas listed below, again building up on existing best practice cases, are to be read as work in progress and should not be considered as final nor as an exhaustive list:

Disciplinary skills
 Transferable skills
 Entrepreneurial skills
 Career development
 Languages, IT Training etc.

Belgium	<p>All Flemish universities provide a well-balanced offer of courses, both domain oriented and transferable skills. Ghent University, for example, offers seminars in transferable skills within four separate clusters: Communication Skills; Research and Valorization; Career Management; Efficiency and Leadership.”</p> <p>The universities of the Federation Wallonia-Brussels are fully autonomous in the field of learning transferable and entrepreneurial skills. These last few years, priority has been given to transferable skills and languages (credits dedicated to transferable skills, specific seminars, human strategies for researchers, etc.)</p>
Germany	<p>All Research Training Groups, Research Schools, university wide schools, IMPRS etc. include skills training in various ways which can be chosen à la carte according to needs and interests.</p>
Estonia	<p>Extra courses for transferable skills training can be organized through Doctoral Schools or curricula development activities, to develop popular science literacy of doctoral students (including seminars, workshops and contest for popular scientific articles). Doctoral students are involved with different projects about making S&T more attractive especially for young people but at the same time develops researcher's popular science communication skills. This kind of extra courses are mostly project based and financed by the government.</p> <p>The Fund of Wise Decisions headed by the State Chancellery was established in 2008, one of its sub-measures is a scheme for building non-governmental analytical capacity. Young researchers' studies in nationally important areas are supported.</p>
Ireland	<p>The Irish Universities Association's (IUA) Deans of Graduate Education Network developed a skills statement of PhD graduates' skills, attributes and qualities, based on an analysis of skills statements already developed and in use in North America, Europe, Australia, New Zealand and elsewhere. This skills statement contains common characteristics of the generic outcomes that result from the research education experience and identifies competencies that are transferable to the workplace, either academic or non-academic.³³</p> <p>National Academy for Integration of Research, Teaching and Learning (NAIRTL)</p> <p><u>TCD-UCD Innovation Academy</u> The TCD-UCD Innovation Alliance, launched in 2010 by the Irish Prime Minister, is a radical new partnership between Trinity College Dublin</p>

³³ http://www.4thlevelireland.ie/publications/Graduate_Skills_Statement.pdf

	<p>(TCD) and University College Dublin (UCD). The TCD-UCD Innovation Academy is the educational centrepiece of this Alliance and is a collaborative educational venture between TCD and UCD, involving interactions with external agencies from both the for-profit and non-profit organisations. The Academy is transforming the doctoral education experience by establishing innovation alongside research and education as an integral element of the PhD. The output will be a new breed of graduate, expert in their discipline, but with the creativity and entrepreneurial skills to convert knowledge, ideas and inventions into products, services and policies for economic and social benefit. Innovation is thus regarded in its broadest sense of exploiting new ideas in a competitive world; it is not restricted to science, engineering, technology and business, but encompasses creativity, leadership, cultural and policy innovation of arts and humanities. The Innovation Academy will enhance Ireland's reputation for PhD education, thus attracting high-quality international students. Students are anchored in the disciplines, where they will pursue original research relevant to key strategic objectives. The Innovation Academy offers a collaborative Graduate Certificate in Innovation & Entrepreneurship to PhD students from across both institutions.</p>
<p>Switzerland</p>	<p>In the Swiss understanding, the purpose of the doctorate is not only the development of academic competence and the acquisition of subject-specific and methodological knowledge and skills, but also the acquisition of transversal knowledge and skills as well as the promotion of academic interaction and networks. In this way, the doctorate prepares candidates for research-based professions at universities or other institutions (public sector, business, administration) and enables them to take on diverse high-level responsibilities and functions.³⁴</p> <p><u>ETH Zurich</u> requires all doctoral students to take a certain amount of coursework ("doctoral studies"). These courses are considered both as a right and an obligation of the students to continue their professional development.³⁵ The objectives of doctoral studies are to enable doctoral candidates, to acquire knowledge and skills in the field of their doctoral thesis, in cognate disciplines and in interdisciplinary areas; to integrate themselves into the scientific community. At least one-third of the required credits must be outside the candidate's research field, covering e.g. transferable skills, entrepreneurship, career development, communication or pedagogic skills. http://www.ethz.ch/doctorate/index_EN</p> <p>Mentoring Programmes for the promotion of female junior researchers</p> <p>Since 2000 the Federal Equal Opportunity at the Universities Programme has been financing mentoring programmes at all Swiss universities in collaboration with the two Federal Institutes of Technology and the Swiss National Science Foundation (SNSF). It intends to promote female junior researchers by giving them career related advice independent from their direct supervisor and introducing them into the academic networks. In</p>

³⁴ See the Joint Position Paper by the Swiss Universities on the Doctorate, <http://www.crus.ch/dms.php?id=6872>.

³⁵ cited from the Ordinance on Doctoral Studies ETH Zurich
http://www.rektorat.ethz.ch/doctorate/admin/en_doc_regulations_2008.pdf

	<p>doing so the concept of mentoring is broad and includes also gender-specific skills training e.g. in rhetoric, job applications, appearance etc. Due to the different cultures of the faculties, there is also faculty-specific mentoring.</p> <p>http://www.crus.ch/information-programme/chancengleichheit.html</p>
UK	<p>Vitae's Researcher Development Statement³⁶ is a UK statement of the knowledge, skills and attributes of researchers in higher education based on the Researcher Development Framework. The Statement has been endorsed by the Universities UK, Research Councils UK and other funders, UK universities have comprehensive training and development provision based on the four Domains:</p> <ul style="list-style-type: none"> - Knowledge and intellectual abilities - Personal effectiveness - Research governance and organisation - Engagement, influence and impact.
EU	<p>Marie Curie Initial Training Network</p> <p>Initial Training Networks (ITN) promote skills training in the fields of:</p> <ul style="list-style-type: none"> - Management and financing of research projects and programmes - Intellectual property rights - Take up and exploitation of research results - Entrepreneurship - Ethical aspects - Communication and societal outreach - Standardisation

³⁶ www.vitae.ac.uk/rdf

National funding for individual doctoral candidates

Having sufficient financial support during a doctorate is a necessary condition for any candidate and generally necessary to find the initial motivation to pursue the arduous and innovative research demanded.

Belgium	<p>Several funding options are open for Belgian doctoral students, based on different employment models. On the one hand a doctoral candidate can be a research assistant, recruited and employed by the university. On the other hand, he/she can profit from a taxfree doctoral fellowship (fully covered by social security!). This fellowship can be paid from university funds, but also research councils provide funding for doctoral fellowships. The most important of these are the Research Fund – Flanders (FWO), the Fonds de la recherche scientifique (FNRS), which both finance fundamental research, and the Agency for Innovation by Science and Technology (IWT), responsible for strategic research.</p> <p>A non-exhaustive list of funding sources:</p> <ul style="list-style-type: none"> • Interuniversity Attraction Poles, which aims at supporting fundamental research led by the university research teams of the various regions of the country working in a network within the framework of collaboration projects • Thematic programme of the Federal Research Office • Mandate “research fellow-FRS-FNRS” (Scientific Research Funds and Scientific Research Fund) • Mandate “research fellow-FRIA” (Research Funds in Industry and Agriculture) • Mandate as assistant in a university • Mandate “FIRST SPIN OFF” (from the Walloon Region in partnership with an enterprise) • Institutional grants for doctoral candidate • Mobilising Programmes of the Walloon Region, which aims at strengthening the scientific potential of universities and HEIs and valuing it in the Walloon industrial context; • Télévie programme, which concerns research on cancer (private funds); • PhD fellowships of the Research Fund – Flanders • Baekeland fellowships of the IWT • Post-graduate Grants of the IWT • Fellowship of the Flemish Special research funds <p>Mandate “Prospective Research for Brussels”</p>
Denmark	<p>The Danish PhD Programme is designed to provide young researchers with skills in order to contribute to the knowledge based economy/society. The general admission requirement is a Master-level degree. A Danish PhD-programme usually lasts three years. The PhD student is generally</p>

	<p>employed in accordance with the collective agreement for PhD students employed in the Danish state. This means that the PhD receives a salary during the three years. The salary is approximately DKK 26.500 per month including pension.</p> <p>Social security is mainly financed by taxes in Denmark and the health service network is based on the principle of equal access to the services offered by the health service for all citizens. PhD students therefore have the same social security rights as others.</p> <p>The Industrial PhD students will receive salary from the enterprise in which they are employed. This salary is agreed upon between the student and the company but must correspond as a minimum to the pay rate of the collective agreement for PhD students employed in the Danish state.</p>
Estonia	<p>A new doctoral financing model will be applied from 2012on: The position of early-stage researcher is added in legal acts as a part of the research career model. Positions of early-stage researcher are foreseen to grant doctoral students full social security coverage. The aim is to enhance motivation and to ensure material support of PhD candidates. Employment contracts will strengthen the link between the university and PhD candidates. From 2012 all doctoral candidates who pass a required attestation will get a doctoral allowance (doctoral students) or a salary (early- stage researchers).</p> <p>Mobility of doctoral candidates for short-term study visits and full-time studies abroad is supported by different mobility programmes (example: Doctoral Studies and Internationalisation Programme “DoRa”, Kristijan Jaak).</p>
France	<p><u>Le contrat doctorale</u>³⁷</p> <p>The “doctoral contract”; this three-year public contract for doctoral candidates, applicable in universities and research institutions, offers a complete package: a comprehensive professional experience, with the required training and additional activities to help doctoral candidates broaden their research experience.</p>
Germany	<p>The majority of doctoral candidates still obtain their doctoral degree while working in a project. In the last years, accompanying training structures have been established at many universities. Various foundations and eleven organisations for the promotion of young talent (Begabtenförderungswerke), funded by the Federal Ministry for Education and Research (BMBF) plus further such organisations funded by some German states, provide individual fellowships for especially gifted doctoral candidates candidates (Landesgraduiertenförderung). The fellowship holders benefit from accompanying programmes fostering their personal and career development.</p>
Ireland	<p>Research Council Project Individual Structured</p>

³⁷ http://editions.campusfrance.org/infos_generales/en/niveau_d_en.pdf
<http://www.enseignementsup-recherche.gouv.fr/cid20185/doctorat.html#les-ecoles-doctorales>

Luxembourg	<p><u>Aides à la Formation-Recherche (AFR)</u> The national AFR PhD grant scheme (www.afr.lu) allocates individual funding for doctoral candidates of any nationality in Luxembourg or abroad, the latter mainly to Luxembourg researchers abroad. Grants are thematically open and have to be submitted by the PhD candidate and the main host institution. Grants cover the costs of a work contract with full social security (paid to the host institution issuing the work contract), plus a training allowance for the full grant period of 3 and up to 4 years. Other costs for PhD training have to be covered by the host institution(s). The provision of transferable skills forms an integral part of the scheme. Calls for proposals are issued twice per year by the National Research Fund in spring and autumn. Proposals are selected on the basis of international peer review by an expert panel.</p>
Netherlands	<p><u>NWO-Graduate Programme</u> The Netherlands Organisation for Scientific Research (NWO) developed the Graduate Programme in 2009. In 2011 the third funding round awarded 19 schools out of 49 applications with 800,000 euros for the training of young researchers. With this financial boost, each school can appoint four PhD students. A total of 38 schools have now received funding for the appointment of about 160 PhD students. All of the PhD students can carry out research for a period of four years. A new funding round for the Graduate Programme is planned for 2012.</p> <p>Within NWO's Graduate Programme, local and national research schools and Graduate Schools can request funding. The Graduate Schools can use this grant to set up a strong education and research programme for the development of young scientific talent.</p> <p>These Graduate Schools offer students a coherent Masters and PhD programme. They focus on talented students who are interested in an academic career. The excellent education and research environments have been developed according to the most successful initiatives worldwide. The Graduate Schools are part of one or more universities and/or institutes.</p>
Norway	<p>Positions as PhDs are announced publicly by the TEIs, and employment is on the basis of competition among applicants. The applicants must apply for participation in doctoral programs separately. The level of funding for PhD positions is comparable to an ordinary public salary, and the candidates enjoy the rights of ordinary employees. Two thirds of PhD candidates have such positions.</p> <p>One third of PhD candidates have other types of funding for their PhD degree. Most of them are employed in permanent positions in TEIs or in the institute sector, and work on their thesis as a part of their ordinary research.</p>
Portugal	<p><u>Bolsas de Doutoramento (BD, Doctoral degree grants)</u> The Fundação para a Ciência e Tecnologia (FCT) in Portugal allows those who are pursuing third cycle studies which lead to a doctoral degree to apply for doctoral degree grants for study in Portugal or abroad, notwithstanding if they are Portuguese nationals or foreigners, as long as they: hold a master degree or equivalent degree, hold a <i>licenciado</i> degree</p>

	<p>(first cycle of studies) but that have an academic or scientific curricula which is considered by the university designated scientific and level structure (e.g., scientific council) as sufficient for the student to be admitted to doctoral training, or have a academic, scientific or professional track which the university designated scientific and level structure (e.g., scientific council)acknowledges to attest the student ability and capacity to pursue doctoral training.</p> <p>The Doctoral degree grants, which can be spent solely in Portugal, in Portugal and abroad, or solely abroad, have a monthly maintenance stipend of 980 Euros in Portugal and 1710 Euros when abroad which is paid according to where the grantee is located. However, other subsidies are available i.e. for travelling, registration, tuition and bench fees.</p> <p><u>Bolsas de Doutoramento em Empresas (BDE, Doctoral degree grants in enterprises)</u></p> <p>The Fundação para a Ciência e Tecnologia (FCT) in Portugal allows the application for doctoral degree grants in an enterprise in Portugal as long it satisfies the same criteria demanded by the eligibility for doctoral degree grants, except that the candidates must be national citizens or residing in Portugal.</p> <p>The purpose of doctoral degree grants in enterprises is to allow doctoral degree grants the opportunity to develop doctoral degree work in the business environment on subjects of interest to the enterprise, as long as this work is accepted by the university that confers the respective doctoral degree.</p> <p>In order to qualify for this type of grant, a plan must be submitted detailing the objectives, the support to be provided for the recipient's research activity in the enterprise and the expected interaction between the enterprise and the university where the recipient is enrolled in the doctoral degree program. The monthly maintenance stipend of 980 Euros is paid by the FCT and the firm on a 50% basis (each pay 490 Euros per month). All the other subsidies are supported by FCT.</p>
Switzerland	<p><u>Swiss National Science Foundation (SNSF): fellowships for prospective researchers</u></p> <p>The SNSF funding scheme “Fellowships for Prospective Researchers” offers also doctoral students the possibility of a stay at a research institution abroad. Eligible candidates from Swiss universities or Swiss nationals residing in foreign countries can submit their application at the earliest 2 years after obtaining their licentiate, diploma or master's degree. This research stay is financed for a period of between 6 and 24 months. The fellowships are allocated in all disciplines supported by the Swiss National Science Foundation. Funding covers the grantee's subsistence costs and includes a fixed sum for travel expenses. It may also comprise a contribution towards research and conference expenses. The amount of the fellowship is based on family status, family obligations and cost of living in the host country. Each year the SNSF awards approximately 160 new doctoral fellowships. Applications submitted by eligible candidates are evaluated by the SNSF research commissions, which are mandated by the SNSF and based at the Swiss universities. One central SNSF panel</p>

	<p>evaluates Swiss candidates that are not affiliated to a Swiss university as they are applying from outside Switzerland. http://www.snf.ch/E/funding/individuals/prospective-researchers/Pages/default.aspx</p>
<p>USA</p>	<p><u>NSF Graduate Research Fellowship Program (GRFP)</u>³⁸ The program recognizes and supports outstanding graduate students who are pursuing research-based masters and doctoral degrees in fields within NSF's mission. The GRFP provides three years of support for the graduate education of individuals who have demonstrated their potential for significant achievements in science and engineering research. In general, graduate fellowships may be awarded only to citizens or nationals of the U.S. or permanent resident aliens of the United States at the time of application. Graduate fellowships are awarded for study or work leading to advanced degrees in science, mathematics, and engineering as specified in the Announcement. Awards are made for 3 years of support, tenable over a 5-year period and are intended for students at or near the beginning of their graduate study. The applications of eligible candidates are reviewed by disciplinary panels. The responsibility for selection of Fellows rests solely with NSF. Each year, NSF awards approximately 1,000 new three-year Graduate Fellowships.</p>

³⁸ <http://www.nsf.gov/pubs/1997/nsf9726/nsf9726.pdf>

Structural Funds (2007-2013)

	Development human potential in the field of research and innovation, in particular through post-graduate studies and training of researchers, and networking activities between universities, research centres and businesses
	Amount in EUROS
AT	412.500
BE	51.034.732
BG	51.000.000
CY	0
CZ	310.811.994
DK	0
EE	76.191.984
FI	24.644.061
FR	16.758.000
DE	251.462.207
GR	281.765.418
HU	576.736.943
IE	0
IT	558.360.513
LV	108.722.551
LT	118.006.500
LU	1.615.595
MT	7.000.000
NL	11.500.137
PL	603.326.307
PT	471.700.000
RO	284.929.959
SK	74.951.515
SI	153.460.471
ES	293.579.426
SE	0
UK	28.778.804
TOTAL	€4.356.749.617

Marie Curie Actions: activities in support of doctoral candidates

Marie Curie Actions are a EU programme supporting activities specifically dedicated to the excellent and structured training of early stage researchers, including doctoral candidates, in all research fields. Financial support is provided for a maximum of 4 years to the institutions which are responsible for the recruitment of early stage researchers according to the principles of the European Charter and Code.

Action Type	Number of doctoral candidates supported	Average grant for the individual doctoral candidate	Average Period	Average grant for the institution
Initial Training Networks (ITN) and Innovative Doctoral Programmes (IDP)	About 9.000 doctoral candidates funded for the period 2007-2013.	<u>Yearly living allowance:</u> €38.000 x country coefficient ¹ <u>Monthly mobility allowance:</u>	36 months	<u>Contribution to the training and research costs:</u> ITN and IAPP: €1800 per researcher-month IDP and EID: €1200 per researcher-month
European Industrial Doctorates (EID-new pilot launched in 2012)	About 100 in 2012.	€700 (no family) or €1000 (with family) x country coefficient to cover expenses linked to the personal household, relocation and travel expenses of the researcher and her/his family in the host country.	36 months	<u>Management activities:</u> Maximum 10% of the total EU contribution <u>Contribution to overheads:</u> 10% of direct costs ²
Industry Academia Partnerships and Pathways (IAPP)	About 2000 doctoral candidates funded for the period 2007-2013.		12 to 24 months	<u>Small equipment expenses (IAPP only):</u> Up to maximum 10% of the total contribution to the SME participant, if duly justified by the project.
International Research Staff Exchange Scheme (IRSES)	About 7000 doctoral candidates funded for the period 2007-2013.	<u>Travel costs:</u> €1900 / researcher-month + 200€/ researcher-month in case of long-distance	From 1 to 12 months	N.A.

¹ coefficient estimated by Eurostat according to the living costs in the host country. The list of coefficients is published in the yearly People Work Programme.

² except for subcontractors and the costs of the resources made available by third parties which are not used in the premises of the beneficiary

ANNEX 3C

Erasmus activities in support of doctoral candidates

Erasmus programme support doctoral candidates through the following activities:

- Erasmus mobility grants
- Erasmus Intensive Programmes (IP)

Estimated support under the current Erasmus Programme (2007-2013)														
Action Type	Doctoral candidates supported			Average grant for the individual			Average Period			Average grant for the institution	remarks			
Mobility grants, PhD candidates	NR PhD Candidates						months			N/A				
		SM	SMS	SMP		SM	SMS	SMP						
	2007-08	3167	2737	438	2007-08	1604.89	1481.41	2346.99	2007-08			5.32	5.51	4
	2008-09	2661	1839	822	2008-09	1806.46	1582.42	2307.67	2008-09			5.14	5.37	4.62
	2009-10	2484	1662	822	2009-10	1784.35	1659.47	2036.85	2009-10	5.16	5.54	4.4		
Mobility grants, staff mobility	PhD Candidates as teaching Assistants						days			N/A				
	2007-08	3316		2007-08	629.58		2007-08	5.81						
	2008-09	3067		2008-09	673.31		2008-09	5.98						
	2009-10	2665		2009-10	622.15		2009-10	5.84						
Intensive programmes (IP)	Intensive Programme 3rd cycle			per Intensive Programme (IP)			Approx. 10 days				IPs are courses of 10 days attended by students and teachers from different countries			
	2007-08	257		2007-08	23234									
	2008-09	319		2008-09	30150									
	2009-10	284		2009-10	32575									
	Nr of PhD candidates on 3rd cycle IPs													
	2007-08	1140												
2008-09	1276													
2009-10	1552													

- SM Student Mobility
- SMS Student Mobility for Study
- SMP Student Mobility Work Placements
- IP Intensive Programmes (10 day courses)

ERC activities in support of doctoral candidates

The European Research Council supports doctoral candidates indirectly through the grant support for selected Principal Investigators. Early analysis of the financial reports reveals that each Principal Investigator is accompanied by one to three candidates.

Estimated support under Seventh Framework programme (2007-2013)					
Action Type	Doctoral candidates supported	Average grant for the individual	Average Period	Average grant for the institution	remarks
ERC Starting Grant	1 to 3 Doctoral Candidates per Principal Investigator	~up to €2.0M and up to €3.5 M per PI and team for up to 5 years for the StG and AdG respectively.	Hard to estimate although in principle a full doctoral study could be easily supported within the 5 years of the grant.	N/A*	Initial analysis reveal that ~70% of the budget goes to personnel costs.
ERC Advanced Grant					

In addition, the Work Programme includes within its provisions for the conditions that the host Institution will provide to the Principal investigator and its team a reference to the Charter & Code.

* although the legal beneficiary of the grant is the institution that hosts the Principal Investigator (PI) and his/her team, the funding is under the control of the PI, including the possibility of "portability", when the PI can leave the host institution with the grant. In other words ERC grants do not constitute institutional funding.